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THE EAST RIVER TUNNEL, from Atlantic Ave., Brooklyn, to the foot of Whitehall St., New York, will be commenced about April 1. Most careful rock borings have been made, the plans are completed, and tenders are now being considered. Mr. CHARLES M. JACOBS, M. Inst. C. E., is the Chief Engineer. This is a part of Mr. AUSTIN CORBIN'S project for rapid transit in New York. The total length between stations will be 4,950 ft.

FREIGHT TRANSPORTATION ON THE GREAT LAKES, for 1889, is the subject of Census Bulletin No. 28. These statistics, gathered by special agents C. H. KEEP and HENRY C. ADAMS, present the tonnage by cargo, by port and by separate lakes and the St. Lawrence River. The total movement of freight in receipts and shipments on all the lakes amounted to 51,203,106 tons. Of this quantity the products of mines and quarries represented 54.22% of the total shipping industry. Lumber gives 23.84% and the products of agriculture 16.50%, leaving a very small margin for miscellaneous goods. The report shows that the average distance carried is 566 miles; and the total ton mileage is 15,518,389,000 ton-miles, or 22.6% of the total ton mileage of the railways of the United States, a telling proof of the relative importance of lake commerce.

THE REPAVING OF NEW YORK is to continue and the third million spent as follows, according to the recommendations of Commissioner GILROY: Without going into the detail of streets, the money will be expended in putting down 101,400 sq. yds. of granite block on concrete foundations, to cost $405,-000; 39,800 sq. yds. of asphalt on present foundations, to cost $159,200; 6,000 sq. yds. of asphalt on concrete foundations, to cost $28,482; 63,155 sq. yds. of asphalt on present stone block pavement, to cost $257,920.

PROGRESS IN STEAM CAR HEATING has been fairly rapid during the past six months, according to a report received from the Consolidated Car Heating Co. This gives a list of railway lines aggregating 37,562 miles in extent, on which the Sewall coupler, which is controlled by the Consolidated Car-Heating Co., is in use. The passenger rolling stock on these roads comprises 7,080 cars. Besides this there are many roads over which run Pullman cars equipped with these couplers. We notice in this list the following roads using steam heat which were not included in our list of June 7, 1890; among Northern roads, the Canada Atlantic, Canadian Pacific, Quebec Central, Penobscot Shore Line, Chicago & Grand Trunk, Cincinnati, Jackson & Mackinaw, and Minneapolis, St. Paul & Sault Ste. Marie; the Southern railways are the Atlantic Coast Line, Louisville & Nashville, Mexican Central, Mexican International, Savannah, Florida & Western, Wilmington & Weldon, Jacksonville, St. Augustine & Halifax River, and the Baltimore & Ohio Southwestern.

Besides these roads, the McElroy and other couplers controlled by the Consolidated Co. are in use on railways having an extent of 8,138 miles, and owning 2,557 passenger cars. An invitation has been sent out to inspect the steam heating apparatus on the Belt Line trains between Albany and Troy on Wednesday and Thursday, Mar. 11 and 12. These trains, as noticed in our issue of Feb. 7, are now equipped with the Consolidated Company's commingler storage system and its automatic temperature regulator.

A COMPOUND LOCOMOTIVE is being tried on the Southern Pacific Ry. It is a twelve-wheel freight engine, which was built as a simple engine at the Schenectady Locomotive Works, Schenectady, N.Y., and was put on the road about two and a half years ago. Under the supervision of Mr. H. J. SMALL Superintendent of Motive Power, the engine has been compounded on the two-cylinder system adopted by the Schenectady Locomotive Works, including the intercepting valve designed by Mr. A. J. PITKIN, Superintendent of the works. New cylinders have been applied, with the intercepting valve, receivers, etc. The engine has only recently been turned out of the shops. Tests will be made as to its efficiency, especially to ascertain what the performance will be on mountain grades. In making the comparison an engine will be used of the same weight and dimensions, with the exception of the cylinders. The following are the particulars of the compound engine: Cylinders, 20 × 26 ins. and 29 × 26 ins.; diameter of driving wheels, 51 ins.; diameter of truck wheels, 26 ins.; wagon-top boiler, 60 ins diameter; firebox, 42½ × 104 ins.; 262 tubes, 2 ins. diameter and 12 ft. 8 ins. long. Grate area, 30 sq. ft. Heating surface, 1,884 sq. ft. Driving wheel base, 13 ft. 9 ins.; total wheel base, 23 ft. 6 ins. Weight on driving wheels, 109,700 lbs.; weight on trucks 23,300 lbs.; total weight, 133,000 lbs. The tender is carried on 33-in. truck wheels, and weighs 71,800 lbs. It carries 3,800 galls. of water and 6 tons of coal. The engine is fitted with the American Brake Co.'s brake.

THE FORNEY TYPE LOCOMOTIVES for the Manhattan Elevated Ry., New York City, of which 13 are now being built at the Baldwin Locomotive Works, Philadelphia, Pa., have the following dimensions: Cylinders, 12 × 16 ins.; diameter of driving wheels, 42 ins.; diameter of truck wheels, 26 ins.; the boiler is of the Belpaire type, 42 ins. diameter; fire-box, 53⅛ × 31⅝ × 43 × 39⅛ ins.; 154 tubes, 1¾ ins. diameter and 6 ft. 3¼ ins. long. Grate area, 16 sq. ft. Heating surface, 430 sq. ft. Driving wheel base, 5 ft.; truck wheel base, 4 ft. 8 ins.; total wheel base, 16 ft. Total weight, 47,000 lbs. The tank carries 512 galls. of water and 1,600 lbs. of coal. The engine is fitted with the Eames vacuum brake on all the wheels.

A TANK LOCOMOTIVE FOR TOWING BARGES through the Muscle Shoals canal, in Alabama, has been built by H. K. Porter & Co., of Pittsburg, Pa. It is of the Forney type, and has the following dimensions: Cylinders, 10 × 16 ins.; diameter of driving wheels, 36 ins; diameter of truck wheels, 20 ins.; boiler, 35 ins. diameter; firebox, 40 × 29½ ins.; 63 iron tubes, 2 ins. diameter, 96 ins. long; rigid wheel base, 5 ft. 3 ins.; total wheel base, 15 ft. Weight of engine in working order, 36,000 lbs., with 25,000 lbs. on the driving wheels. The tank is over the trailing truck, and carries 500 galls. of water, while the bunker carries 1 ton of coal or ¾ cord of wood. Hand brakes are fitted to the driving wheels. The engine is fitted with 4 heavy towing hooks, 2 on each side, but foreign experiments have shown the best results with a tow car coupled behind the engine. Lt. Col. J. W. BARLOW, U. S. Engineer Office, Nashville, Tenn., states that the details of towage through the canal have not been fully determined upon, and must be somewhat experimental. It is intended to attach the tow lines to the locomotive, as a tow car will be inconvenient. The distance is about 15 miles, and the load to be hauled is variable, consisting of steamboats, barges, rafts, etc. The line has a gage of 48 ins.

THE MOST SERIOUS RAILWAY ACCIDENT which has occurred for some time was a rear collision, Feb. 20, near Eighty-fifth St., New York City, in the tunnel approach to the Grand Central station at Forty-second St. A New York, New Haven & Hartford train from this station ran into a train of cars which was being taken to the yards above Mott Haven to be cleaned. The two rear cars of this latter train were telescoped by the locomotive of the passenger train, and the wreck of these two cars caught fire and was burned. In the rear car were about a dozen sweepers and cleaners, of whom 7 were killed, 2 of them being burned to death. The tunnel is operated on the Sykes block system, and has auxiliary gong signals of the form illustrated on another page. The accident is interesting in connection with the article in ENGINEERING NEWS, Jan. 31, 1891, p. 106, showing that some of the worst accidents on English railways have occurred on lines where the block system is in operation. The question of responsibility lies between the engine driver and fireman and the signal men. The former declare that the signals showed a white light, and that the gong did not sound, thus indicating a clear track ahead. The latter declare that the signals were set at danger, and the operator at the Seventy-second St. tower telegraphed the operator at Eighty-sixth St. that the passenger train had run past the danger signal at Seventy-second St. A trackwalker who examined these signals also states that they were at danger, but no evidence has been given that the gong sounded. The wreck was set on fire by a stove in one of the wrecked cars belonging to the New York, New Haven, & Hartford R. R., which road has persistently refused to adopt any steam heating system, but is said to have decided since this accident to adopt some such system.

ANOTHER SERIOUS RAILWAY ACCIDENT occurred Feb. 25, near Hagerstown, Ind., on the Chicago, St. Louis & Pittsburg R. R. An express train was derailed near a bridge, and some of the cars went down into the canal, a parlor car turning over twice in its descent. The cars caught fire, but the flames were quickly extinguished. There were four persons killed, two fatally injured and about 26 more or less seriously injured. A combined derailment and collision accident occurred Feb. 18, near Medina, Tenn., on the Illinois Central R. R. A passenger train was derailed on a trestle and the baggage and express cars were upset and caught fire from a stove. A flagman was sent out, but not in time to stop a following freight train, which ran into the wreck, overturning two passenger cars, which, with a sleeping car, were also burned. Two persons were killed and 4 or 5 injured. A rear collision occurred Feb. 24 on the Philadelphia & Reading R. R., near Ashland, Pa., between a freight train and three light engines which had been stopped on account of an accident to another freight train in front. Five oil-tank cars caught fire, and the four engines and several freight cars were burned. A Missouri Pacific R. R. roundhouse, at Kansas City, Kan., was burned last week, and 18 engines were destroyed, including 4 switch engines, 3 passenger engines and 11 mogul and consolidation freight engines.

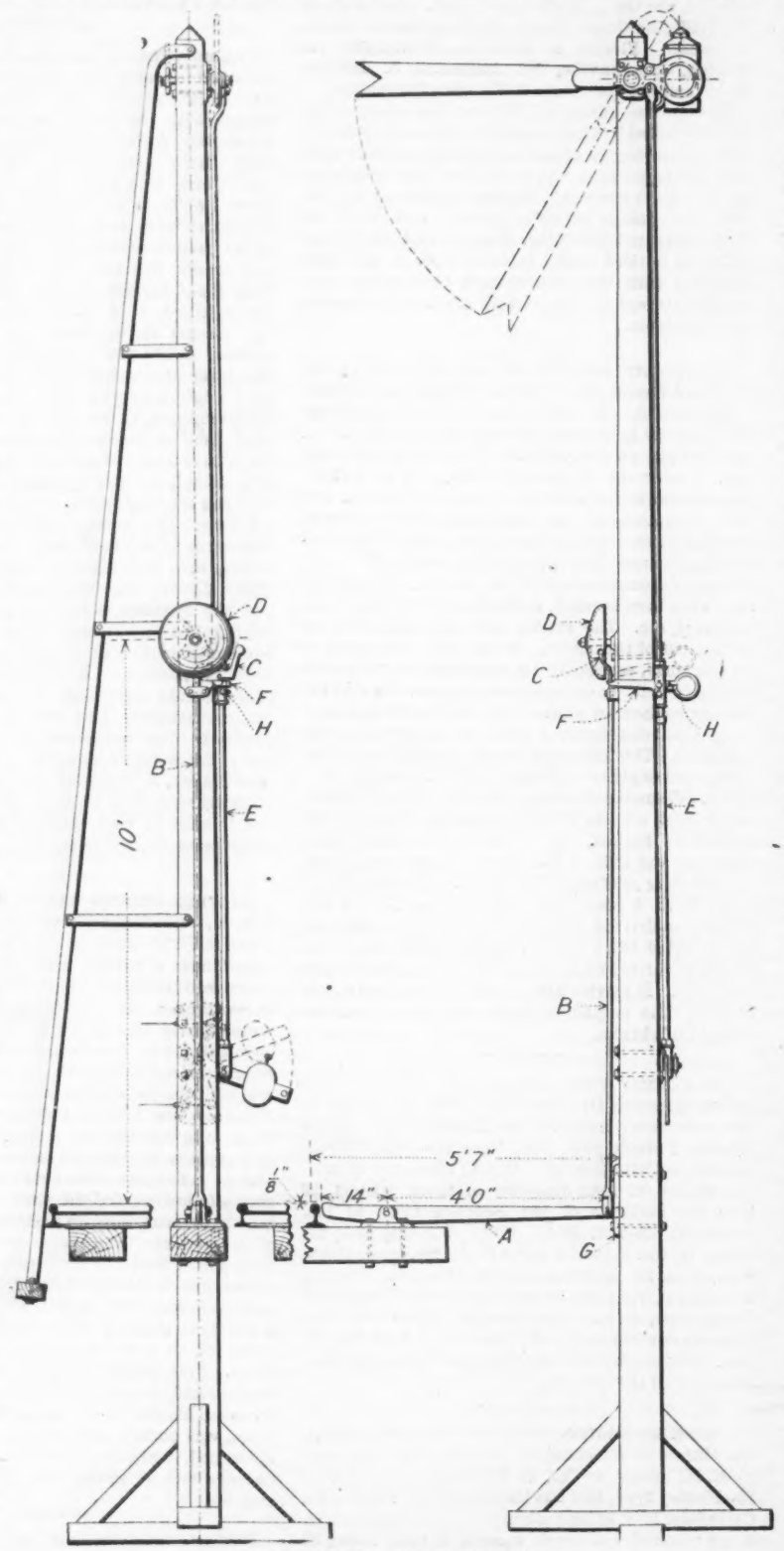
BRIDGE ACCIDENTS are reported as follows: On Feb. 20 a bridge on the Pittsburg, Shenango & Lake Erie R. R. gave way under a freight train and six cars were thrown into the river. A bridge on the Maricopa & Phœnix R. R., near Tempe, Ariz., was carried away by a flood Feb. 20. On Feb. 19 a bridge near San Marcial, N. M., on the Atchison, Topeka & Santa Fe R. R., was destroyed by fire. A trestle on the Union Pacific Ry., near Cascade Locks, Ore., gave way Feb. 23 under a passenger train; several persons were injured. A derailed car loaded with pig iron caused the wreck of a trestle near Guin, Ala., on the Kansas City, Memphis & Birmingham R. R., Feb. 17.

The Kelsey Gong Signal.

With the introduction of the block signal system, which is becoming more and more general, and with the increase in the traffic and number of trains on busy lines of railway, there is a growing field for the use of auxiliary signals to notify an engine driver when the regular signal is at the danger position, or to warn him in case of his accidentally or carelessly running past a signal when at that position. Many auxiliary signals have been designed for this purpose, effecting their object by sounding the engine whistle, placing torpedoes on the rail, or by other means; while some of them are intended to apply the brakes to the train in the event of the engine driver attempting to pass the danger signal.

The Kelsey Railroad Signal Co., of Florence, Mass., makes a specialty of an auxiliary gong signal, and the accompanying cut shows a distant signal with this gong attachment. The gong is operated by means of a track lever *A*, the rail end of which is ⅛ or ¼ in. above the level of the head of the rail, so that it will be depressed by passing wheels. The inner end of the lever is attached to the lower end of the rod *B*, giving it an upward stroke as each wheel passes. This rod *B* has a projection on the upper end, which at every down stroke, when the signal is set to "danger," strikes the horizontal arm of the hammer *C* and causes it to strike the gong *D*, thus giving a beat on the gong for every wheel of the train which passes the signal when it stands at the danger position. When the signal is lowered to indicate "track clear," the signal rod *E* is raised, and by lifting the lever *F* brings the hammer *C* against the gong. In this position the inner end of the hammer is out of reach of the projection on the top of the rod *B*, the travel of which is limited by the stop *G* at the foot of the post, so that the gong is not sounded. The slot *H* is provided in case the signal rod *E* in rising should require more travel after the gong hammer has been thrown against the gong. The normal position of the signal is at "danger," with the gong free to sound. In case of the wire breaking, both visible and audible signals go to the danger position.

This gong attachment is in use on the four tracks of the tunnel near the Grand Central Depot, New York City. It is attached to the home signals, which are pot signals instead of semaphore signals, in consequence of the limited space, but the gong is operated in the manner above described. There is a very heavy traffic over these tracks, and the tunnel is frequently obscured by steam and smoke from passing engines, especially in bad weather. As there would be so many chances of accident in case of a train overrunning the signal, and as an accident would severely hamper the traffic, this audible signal has been put in as a safeguard. It has been in service about a year at this place. This is the signal about which so much has been said in the daily press in connection with the collision which occurred in the tunnel on Feb. 20, and which is referred to in another column. It is claimed by the signal operators that the signals were set at danger against the passenger train, while the engine driver and fireman swear that the signals indicated track clear, and that the gong did not sound. If the signals indicated track clear the gong hammer would be thrown out of gear, as above described; while if they were at the danger position the gong should have sounded as each wheel of the train passed the signal, and would almost certainly have been heard by some one on the train. So far there has been no evidence that the gong was heard. One of the signalmen has stated that in some cases, owing to the stretch of the wires, the signals do not completely change their position when the levers are pulled.



THE KELSEY GONG SIGNAL.

The Proposed Water Supply of Butte City, Mont.

Butte City, Mont., has been supplied with water since 1881 by the Silver Bow Water Co. The supply until July 1, 1882, was a temporary one. The first supply was brought from Bull Run gulch, north of the city, by gravity through a wooden flume seven miles long, laid in a ditch and covered to a depth of 2 ft. Two covered reservoirs, with capacities of 75,000 and 85,000 galls. respectively, received and distributed the supply. The mains leading from the reservoirs were of lap-weld wrought iron pipe, 5 ins. in diameter. These were connected by a cross pipe, 2 ins. in diameter. There were 8 fire hydrants.

The population in 1880 was but 3,363 (it is now said to be 23,000) and the above supply did very well at the first. The principal cause for its introduction was the gradual failure of the wells, which were drained by the mines beneath and near the city.

The company soon bought from a mining company the surplus water from Yankee Doodle Gulch, but during the dry season the supply was often very limited and sometimes wholly inadequate. Therefore, in 1887, a 1,000,000-gall. pumping plant was put in at the junction of Silver Bow and Blacktail Creeks, about 1¼ miles from the city, an 8-in. kalamein force main was laid to connect with the distribution, and water was pumped from the streams named or from wells near by. Later this supply was abandoned, at least temporarily, and water is now brought by gravity to the pumping station from Basin Creek, through about 11 miles of covered flumes and iron pipe.

The supply from the sources named not being sufficient, and from the start diminishing in quantity, owing to the cutting of timber from the drainage area, additional water rights have recently been secured in German Gulch, west of the city, and during the coming season it is expected that water will be introduced from this source.

It seems that a large proportion of the inhabitants of Butte are necessarily patrons of the water company, owing to the failure of the wells. In addition, large quantities of water are required by the mining companies. Unfortunately, the water in the mines is not suitable for mining and allied purposes, so a purer supply is required even for pumping out the mine water. The ores are said to be chiefly sulphides, and the water corrodes iron very rapidly.

This lack of suitable water, it is said, and its abundance in Warm Spring Creek, 30 miles away, led the Anaconda Co., early in 1882, to locate its concentrating and reducing works on or near the creek, thus founding the town of Anaconda.

This necessitates the shipping of the Anaconda Co.'s ores some 30 miles by rail, while the Butte & Boston Co. is putting in a reducing plant at Great Falls, 99 miles distant. Other companies are pumping all the water used for concentrating, and some are looking about for suitable locations elsewhere.

From the above it will be seen that there is an unusually large demand for water at Butte, aside from that needed for domestic purposes. The Anaconda Co. has let contracts for a tunnel through the range 4,000 ft. in length, preparatory to bringing their own supply of water to the city from the Little Boulder. They have already offered to supply the city with water, but have not secured a franchise.

On Feb. 19, 1890, the city granted a franchise for water-works to the Silver Bow Hydraulic Mining Co. This company acquired or owned, it is said, water rights at the head of the Divide and Jerry creeks. Moffett, Hodgkins & Clark, Syracuse, N. Y.

are accredited as having, with others, bought the franchise and rights of the above company, which did no work, with a view of organizing the Butte City Water Co. Representatives of this proposed company applied for a 30-year exclusive franchise from Butte City, and a contract for 400 hydrants at a yearly rental of $42,000, or $105 each. From other and smaller towns they hoped to raise their yearly hydrant rental to $60,000.

Through the month of December an animated discussion regarding the three water companies in the field, the existing and the proposed, was carried on, both among the people and through the local papers, the *Inter-Mountain* and the *Miner*, and the Anaconda *Standard*, which has a large circulation in Butte. The discussion resulted in the abandonment, among other things, by the Butte Co. of the request for a 30-year exclusive franchise, which was most decidedly and sensibly protested against. The Anaconda Co., as noted above, offered to supply the city, but at a yearly hydrant rental of $12,000 for 100 hydrants. Meanwhile, the old water company said little, but claimed that it would soon introduce an additional supply. Finally, the Butte City Water Co. withdrew its application for a franchise, although it has by no means abandoned the project, and its representatives are reported as saying that surveys will be made, and the works built.

Whatever the outcome of the various schemes may be, it seems probable, almost certain, that a large amount of work will be done at Butte within a short time. The Silver Bow Water Co. is practically forced to extend its works, as the supply is so inadequate, and the city has less than 50 fire hydrants for its protection. The Anaconda Co. has commenced new works, and estimates the total cost at $750,000 or more. The Butte City Water Co. estimates the cost of its proposed works at $2,000,000.

It should be added that there are no available sources for a gravity supply nearer the city than about 15 miles, and it is stated that with one exception all the important available water rights have been taken by the three companies, and the water from the remaining source is not regarded with favor. Outside of the sources named the nearest supply considered desirable is the Big Hole River, 100 miles distant.

We have given this much space to these projects because of the importance of the work which seems likely to be done soon. We are largely indebted to J. H. HARPER, City Engineer of Butte, for the information presented.

Notes On English Railways.

(*Continued from p 176.*)

GREAT WESTERN RAILWAY.

Rolling Stock.—On this road, as on many English roads, there is a great variety of passenger cars of different dates and styles. On some of the more remote parts of the broad gage lines are to be seen the old fashioned six-wheel cars with four compartments, having generally small windows. At the time when these cars were built, passengers' baggage was carried on the top of the cars, and a portion of the roof is surrounded by a low railing, to which were attached the straps and tarpaulins for securing the baggage. Many of these old cars have been dismounted, and are used as section houses, yard offices, etc. A number of broad gage cars of more recent date are still in use, but the best cars on the broad gage trains have standard gage bodies mounted on broad gage frames and trucks, a wide step being built along each side to fill out the space between the side of the car and the edge of the station platform. The reason for this is that few if any broad gage car bodies are now built, in consequence of the probable future abandonment of that gage. Broad and standard gage car bodies are run in the same train. There is a very large proportion of the ordinary style of car, with 4, 5 or 6 compartments (seating 40, 50 or 60 passengers), and carried on two or three rigid axles. Some of them have seats 22 ins. wide and 22 ins. clear between the seats. These cars have generally one oil lamp in the roof of each compartment. Some of the newer first-class cars have lavatories. Saloon cars may be hired by parties of passengers wishing to travel together in a special car, but they must have a certain minimum number of first-class tickets and pay an additional sum for the use of the car. These cars may also be hired at special rates by excursion parties, etc. They have as a rule a baggage compartment at one end, and a smoking room and a private compartment at the other end; the rest of the car is taken up by the saloon, which has tables in the middle and seats round the sides, a very poor arrangement for seeing the scenery. The guard's vans and compartments have often a portion of the sides extended and fitted with windows, so that the guard can see all along the train. The underframes are now built of steel.

On the express trains, long cars carried on four-wheel trucks, or "bogies" with steel plate frames, are very generally used. They are fine cars, and many of them have monitor roofs, gas lamps and other modern improvements. The arrangement of these cars varies considerably; some have 8 third-class compartments (seating 80 passengers); others have 6 third-class compartments and a baggage compartment; and others have 3 first-class (one being a saloon), 3 second-class and a baggage compartment. In some cases the arrangement is still more comprehensive, as follows: At one end a first-class coupé compartment (*i. e.*, with a seat on one side only of the compartment, and windows in the end of the car), at the other end a second-class coupé; between them are 1 first-class compartment, provided with a lavatory, 1 second-class and 3 third-class compartments, and a baggage compartment. Such a car is 48 ft. 7 ins. long over the body, 8 ft. wide; 7 ft. 2½ ins. high inside, or 8 ft. 7 ins. to the top of the monitor roof; total height from rail, 12 ft. 6¼ ins. The total wheel base is 38 ft.; the trucks have 42-in. wheels, with a wheel base of 6 ft. 4 ins. The body is stiffened by truss rods. They are upholstered in the modern style, with comfortable cushioned seats and high padded backs. The upholstering is generally of carpet cloth, either of a dull yellowish brown color, or a dark brown with a small red and black pattern. Removable cushions are sometimes used, there being two cushions to the length of the seat. The second class cars have a strip of carpet on the floor between the seats, and oilcloth under the seats; the lower part of the inside of the door is generally padded and covered with leather. The third-class cars are fully as comfortable, but have bare floors or cocoanut matting. Many of them have the partitions decorated with well-printed photographs of scenery at places reached by the railway. Baggage racks, for light hand baggage, are fitted in each compartment. The roof boards are generally bare, and painted white. The monitor roof has sliding ventilators in the sides at each compartment. These consist of two wooden plates having a number of narrow vertical slots; the outer plate is fixed, and is protected by a bonnet outside the car, while the inner plate can be moved horizontally by means of cords and handles, so as to open or close the slots. Similar ventilators are almost invariably fitted in the upper part of the doors of passenger cars. The rest of the side of the monitor roof is paneled in wood or with ornamental ground glass. Some of these cars are lighted by gas, having a globe with two burners in the middle of the roof, placed sufficiently low not to throw the shadow of the edge of the monitor roof. Other cars have two oil lamps in each compartment, placed in the lower part of the roof, one on each side of the monitor. The gas light is in general very unsatisfactory, being inadequate for reading. Nothing like the brilliant lighting, common in this country, is to be found. Oil lamps are often worse, serving only to make the darkness visible, especially when used during the day time for trains passing through the Box and Severn tunnels, the lamps being then trimmed so low as to shed little light, but to give out a vile smell of oil. In many cases, on the less important trains, where cars are fitted for two lamps in each compartment, only one is put in. The whole system of car-lighting on this road, as on many others, is very unsatisfactory; it seems to be an object to use the smallest possible quantity of oil, which is a very poor policy for a rich company. The lamps themselves are generally of a bad form for giving the light to the best advantage. The windows are large, and are fitted with spring roller blinds, or with loose blue curtains hung to rings on a curtain rod across the end of the compartment. In each door is a large sliding sash, which drops down into the lower part of the door; it is held at any desired height by means of a leather strap attached to the bottom of the sash, and having holes to fit over a brass stud on the door. Short six-wheel mail cars are generally coupled in pairs, having a vestibuled gangway between them, but long mail cars on four-wheel trucks are also used. The wheels have a solid wooden center secured by retaining rings. At the ends of the cars are step plates and hand rails to the roof, for the use of the men who attend to the lamps, lavatory tanks, etc. The outside appearance of the cars is very handsome. The lower part of the body, to the level of the window sills, is a dark vandyke or sepia brown, while the upper part is painted cream color, with black and gold striping. Horse and carriage cars, milk cars, etc., are painted a dark brown and lettered in yellow.

The journals are lubricated with a stiff grease, known as train oil. At important stations the car wheels are tapped with one, two or three blows of a hammer, and boys attend to the axle boxes. Each boy carries a large tin box of the grease and a long piece of iron, like a blunt, stiff knife; with this "knife" he strikes up the hinged piece of the footboard over the axle box and the cover of the box, stabs and presses the grease, adds fresh grease if necessary, and knocks down the cover and the piece of the footboard. These operations are done very rapidly. The cars are coupled by link and hook couplings, which are drawn tight by a right and left hand screw. Two slack safety chains are also used. The cars have at each end two long spring buffers. The trains are fitted with the vacuum automatic brake. On six-wheel cars the four outer wheels have squeeze brakes, while four-wheel trucks have squeeze brakes on every wheel. The brake shoes are of cast-iron. The iron pipe is carried up vertically about 30 ins. at each end of the car, and the hose is attached to the top of this pipe. The hose is larger than that used with the Westinghouse brake. With the automatic vacuum brake the engine driver has to keep the brake off, and if a pipe breaks or leaks the brakes will go on. With the old form of non-automatic brake, the driver had to keep the brakes on when needed, and if there was any defect in the pipes or apparatus the brakes could not be applied. The brakes can be applied in emergency by the guard of the train. When cars are standing the brakes can be let off by means of a handle at the side of the frame, which opens a release valve.

Some of the fast passenger trains have "horse boxes," carriage trucks, milk cars, etc., attached at the rear, and these, as well as similar cars for fast freight service, are fitted with brake pipes and hose, and sometimes with brake gear. The "horse boxes" are short, high, four-wheel cars, with stalls for horses, a compartment for an attendant, and generally a compartment for dogs; those fitted with the continuous brakes have squeeze brakes on all the wheels. Carriage trucks are short, low-sided flat cars, without ends, for carrying vehicles. Milk cars are generally six-wheel box cars, with open sides, not unlike American fruit cars; they are about 25 to 30 ft. long. Some old passenger cars are converted into milk cars by removing all interior partitions, seats, etc. Long six-wheel freight cars with low sides are also used in fast freight trains for carrying boxes of fish, etc. Most of these cars, as well as many ordinary freight cars, have iron or steel frames. Refrigerator cars are short four-wheel box cars. Cattle cars are short four-wheel box cars, with the upper part of the sides open. The ordinary freight cars are short four-wheel open or box cars; some of the open cars have high semi-circular ends. Open and box freight cars built of iron are used to some extent, and both iron and wooden ballast cars are in use. Hay is generally piled on open cars and covered with tarpaulins. A special car built of iron was seen which was used for carrying large, heavy articles up to 12 tons weight; at each end was a single pair of wheels, and between the axles the floor was depressed to within a short distance from the rail. Laminated springs are used on some freight cars, those for coal cars having 10 leaves and those for ordinary cars 4 leaves. Spring buffers of various designs are extensively used on freight cars, but many of these cars have only wooden buffers or bumpers formed by making the "soles" or sills longer than the body of the car; the ends are hooped with iron to prevent brooming. In some cases link and screw couplings are used, as for passenger cars, but in general freight cars are coupled by chains, leaving considerable slack which results in much wear and tear and noise in starting and stopping.

Freight trains are controlled by the brakes on the engine and the caboose or "guard's van." Many of the cars have a brake acting on two wheels, with large wooden brake shoes, but it is applied by forcing down a long lever at the side of the car and fixing it in the tooth of a rack or by a pin, so that it can only be applied by a man standing by the track. These car brakes are only used in switching, or for going down steep grades, in which latter case the train stops at the head of the grade, and the guards or trainmen pin down the brakes on a certain number of cars, according to the weight of the train. There has been considerable discussion during the last year or two in regard to the respective merits of the English system of small freight cars with light loads, and the American system of large cars and heavy loads. It has been claimed the E. glish railway managers are prejudiced and behind the times in adhering to their present system, but it should be remembered that the character of the freight traffic is very different in the two countries. Mr. ACWORTH in his "Railways of England" states the case very clearly as follows:

It is quite true that our trucks weigh much heavier in proportion to their load than those in use in America, but the fault I have most often to find with them is not that they are too small, but that they are too large. They will carry 7 tons, but I should think myself very lucky if they took, as a rule, the half of that weight; often, and especially in the slack time of the year or when trade is depressed, they do not carry the quarter. Our trade and that of America are totally different; American lines carry hundreds of train loads and tens of thousands of tons half across a vast continent. Thirty-ton trucks are in their right place there, but what should I do with them to carry a couple of tons, say, from Bradford to Southampton? If English customers would be satisfied with goods trains run at the American speed of 12 or 15 miles an hour it would be a different matter; we then might possibly load goods for different places in the same truck, and stop to unload them en-route. But that will not do for English people; if the goods were not alongside the wharf in Southampton the next morning, the Bradford manufacturer would soon transfer his custom to one of our competi ors

For the greater part of the freight traffic on English railways the large American cars would be an absurdity; but there is a certain field for them in carrying quantities of freight, such as coal, ore, etc., for which work they would be more advantageous than the great number of small cars now used to make up a train load of coal, etc., for a through run. Some American gondola cars have been in use on the Furness Ry. for some time. While the English style of freight car is very well adapted to the nature of the traffic, it is probable that its construction could be considerably improved.

Every passenger train making a run of more than 20 miles without a stop is required by the Board of Trade to be fitted with some means of communication between the passengers and guard and the engine driver. A few roads, including the London, Brighton & South Coast Ry. and the Southeastern Ry., have electrical intercommunication on their trains, but the most usual method is the "communication cord," which is led through pulleys or rings under the eaves of the roof of the cars from the engine to the rear guard's van, and a pull upon which sounds a gong on the engine or on the side of the tender and in the van. At opposite ends of each compartment are the following notices, printed in black on a white card about 6 × 3½ ins., and mounted in a gilt frame 1 in. wide:

All trains upon this railway which run during any part of the journey a greater distance than 20 miles without stopping are provided with a means of communication between the passengers and the servants of the company in charge of the train.

To call the attention of the guard and driver, passengers must pull down the cord which will be found outside the carriage close to the cornice, over the window of the carriage door. There are cords on both sides of the train, but that on the right-hand side in the direction in which the train is traveling is the one by which alone communication can be made.

Passengers are earnestly requested to protect the communication from improper and mischievous use, as it is very important that it should not be used without real and urgent necessity. Under the regulations of Railways Act, 31 and 32 Victoria, Cap. 119, any passenger who makes use of the means of communication without reasonable and sufficient cause is liable, for each offense, to a penalty not exceeding five pounds.

The other notice is as follows:

The carriage racks are provided for the reception of light articles, such as rugs, umbrellas, small hand bags and parcels, and passengers are earnestly desired not to use them for any other purpose. The company's servants have instructions not to place articles of heavy baggage in the racks.

This latter notice is very generally disregarded, as the troublesome baggage system, and the chance of loss, though the absence of any system of checking, induce passengers to take large bundles, packages, valises, etc., with them into the compartments instead of placing them in the baggage car or compartment.

Stations.—Most of the stations near London are light and cheerful, and are kept neat and in good condition. They are of brick or stone, with wooden or iron and glass coverings over the platforms. Many of these stations have the platforms paved with large blue bricks, having the tops chequered, near the station buildings, while beyond they are of gravel, with a coping of wide flagstones. The platforms are level with the floor of the cars. In accordance with the requirements of the Board of Trade, footbridges or subways are provided for passengers wishing to cross the line. Fig. 12 is a general plan, showing the main tracks only, of the union station at Bristol, which is a good example of its class. The terminal portion is the old terminus of the original Great Western Ry. The through lines have the disadvantage of being on a curve, so that in some cases the conductor, or "guard," has to run out into the crowd on the platform in order to signal the engine driver by whistle and flag to start the train. The through part of the station has a single span arched roof of fine appearance. The platforms are lighted fairly well by large gas lamps suspended by pipes from the roof; each lamp has three burners, bent so that the tips point toward one another. The main building is of stone, and stands at the top of an inclined approach. To the east of the station are extensive freight yards, considerable extension of which has been made by excavating a large part of a high hill through which the line formerly passed by tunnel. The engine sheds, repair shops, etc., of this division are to the west of the station. There is a great congestion of traffic here, and a relief line is being built to enable through freight trains to avoid the passenger station. The station is also to be enlarged. Some of the older main line stations are built with turrets, castellated walls, and other details for architectural effect; and the same style, with Norman arches, etc., was adopted for some of the tunnel portals, overhead bridges, etc. The material generally used in the west of England was Bath stone, which is soft and easily cut when newly quarried, but hardens after exposure. It is much used for buildings, but sometimes turns a dingy black color. It is not durable for railway work, as it decays badly. In some cases decayed stones in arches, retaining walls, etc., have been cut out and brick-work substituted, making a rather patched effect.

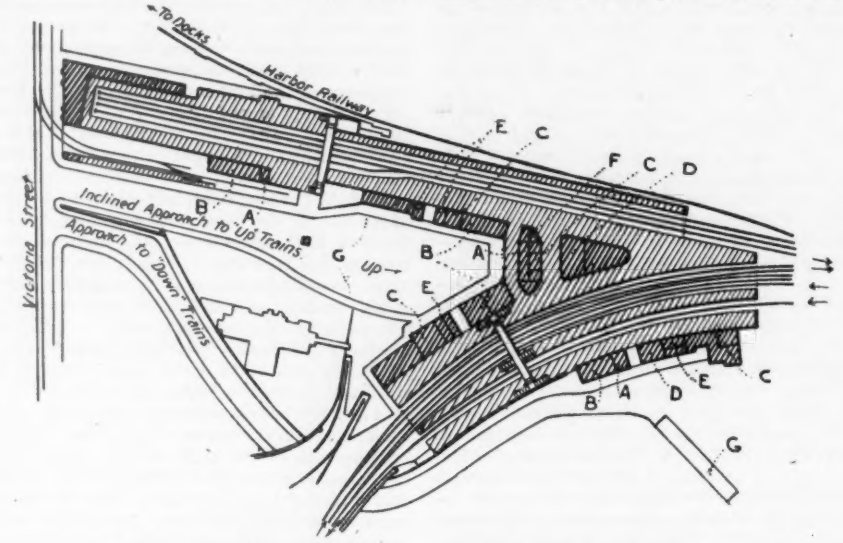


FIG. 12. PLAN OF UNION STATION, BRISTOL, ENGLAND.

A, Ticket Offices; B, Waiting Rooms; C, Baggage and Cloak Rooms; D, Refreshment Rooms; E, Lavatories and Closets; F, Telegraph Office; G, Cabstands.

Bridges.—There are numerous brick and stone highway bridges of the general style shown in Fig. 13, the arch springing from abutments (or footings in rock) in the slopes of the cut. Near London the tracks spread apart in places so that overhead bridges have a pier between the tracks. One wooden highway bridge was noted, having a framed bent on each side of the track, resting on a foundation of masonry and having struts to support the roadway. With iron bridges floors of iron transverse troughs filled with ballast are much used. A rather curious iron through bridge near Newport has riveted chords, the upper one being arched, with pin-connected members; each member is in two lengths, connected at the middle by pins. Another peculiar bridge is a plate girder through bridge with an arched upper chord of tubular form. On the new widening of the line from Bristol to the Severn tunnel there is at

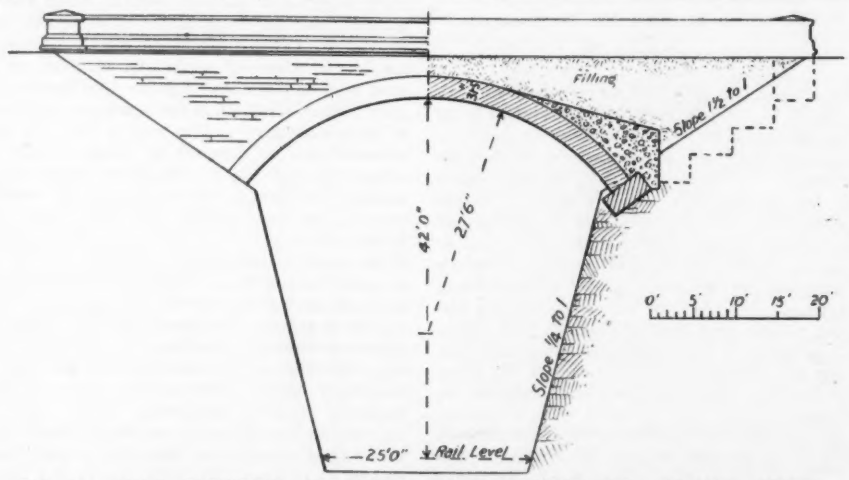


FIG. 13. HALF ELEVATION AND HALF CROSS SECTION OF HIGHWAY BRIDGE.

Stapleton Road a riveted truss, double-track, through bridge of three spans, on cylinder piers; the top chords of each span are curved slightly, and are connected by three light transverse lattice girders, which are raised high enough to give the necessary headway for the locomotives. The arrangement is extremely ugly. The great Box tunnel and a short tunnel at Bourton, near Bristol, are in the rough rock, unlined. The ventilation of the Severn tunnel is very effective. The company's locomotive and car works are at Swindon. It has also creosoting works at Hayes and gas-compressing works at Acton, both near London.

Alignment.—The main line between London and Bristol has remarkably easy grades and curves, except that at Bath there is a long, sharp curve on a viaduct through the city, which necessitates the slowing down of all through trains. On other divisions there are steep grades, however. Between Kemble and Brimscombe, on the South Wales line from Swindon, is a heavy grade, on which a pusher engine is used for up freight trains; down mineral and freight trains must stop at the head of the grade and have the brakes applied to some of the cars. The short single track line from Monmouth to Coleford climbs up by grades of 2.0 to 2.5%, which are combined with a succession of sharp curves and reverse curves; the line is very serpentine, and the check rails appear to be almost continuous, on one side or the other. The main line to the west of England is free from competition except for the through traffic between London and Exeter, the London & South western Ry. reaching Exeter by a very different route. There is consequently some competition in the express service between these points, and both companies put on additional and faster trains last summer. Trains on this line are not very punctual, even the expresses rarely keeping on time; although they do some very fast running in places, up to 60 or 65 miles per hour regularly. The 10:15 A. M. broad gage express from London is timed to make the run of 118 miles to Bristol (with one stop) in 140 minutes; the writer has known it to make the run in 145 minutes, including twice slackening speed and one stop of 12 minutes; this was exceptionally good work. The train consisted of 2 baggage cars and 6 long cars on four-wheel trucks, hauled by an engine with a single pair of driving wheels, of the type shown in Fig. 9 (page 175). Delayed freight trains are sometimes switched on to the other track in order to allow a following passenger train to pass. Local trains were found to be from 5 to 15 minutes late. Express trains are sometimes delayed just before reaching Swindon and Bristol; this is due partly to the heavy traffic, but also, apparently, to bad management in not keeping the track clear for such trains. In one case the "Flying Dutchman" express was so stopped, losing 5 minutes clear, exclusive of the time lost in stopping and then pulling slowly into the station. This is one of the crack broad-gage express trains between London and Exeter, and makes its fastest running between London and Bristol. Until October, 1890, this train carried first and second-class passengers only; but since then third-class passengers have been carried, and all trains now have third-class accommodation. This and the great improvement of the cars are proofs of the growing importance of the third-class traffic.

On through trains, making few stops, the tickets are examined, and sometimes punched, at each stop by special officials, or "ticket inspectors," and tickets for the next stop are taken up. With local trains, passengers alighting at each station show or give up their tickets on leaving the station; if the terminal point is a large and busy station, without barriers, all the tickets are examined and taken up by inspectors at the last way station. This causes considerable delay. Just before the departure of the 5:30 A. M. mail and newspaper train from the Paddington terminus, London, a set of men may be seen busy at trestles on the platform folding up newspapers in addressed wrappers. The lunch basket system of refreshments is supposed to be in operation on this line, but it does not work well, as passengers often cannot get at a refreshment station the lunch baskets for which they have wired from the previous stopping place. Between London and Reading the line runs for some distance parallel with an old canal, across which are several balance lift bridges. The canal was purchased by the railway company a good many years ago, and there is now no competition and but little traffic.

Wages.—Signalmen begin at about $4.40 per week and may rise to about $7.25; in addition they get a bonus of $10 to $25 per annum, according to the time they have been in the service. The company furnishes clothes (which is estimated as an addition of 18 to 50 cts. per week to the wages), and they are paid overtime for Sunday work. Passenger guards or conductors get from $5.25 to $10 per week, and clothing, which is estimated as an addition of about 36 cts. per week. Freight conductors get from $5.25 to $8.50, with an additional 30 cts. per week in clothing. In the locomotive department boys begin at about $1.70 per week. Engine drivers of experience get about $16 per week; and each man gets a bonus of $50 per year if his record is clear; they are also supplied with overcoats, and these additions bring the wages up to an equivalent of about $17 per week.

E. E. R. T.

(To be continued.)

Progress Report of the Am. Soc. C. E. Committee on Standard Rail Sections.

(Concluded from p. 178.)

The following are extracts from communications sent in by members of the Am. Soc. C. E. Committee on Standard Rail Sections in explanation of their respective designs, which were illustrated in the last number of this journal:

Mr. G. BOUSCAREN writes: . . . for 40, 60, 80 and 100 lbs. steel rails, and a tabulated statement giving the dimensions and all other elements of these sections.

The rulings taken for guidance in their preparation are:

First.—Weight of metal, 1 sq. in. area, 1 yd. long = 10.20 lbs. To facilitate comparison we should have agreed on a modulus for the weight of steel at our last meeting. I suppose there will be some variations as to the modulus assumed by the different members of the committee.

Proportions aimed at between areas of head web and flange: Head, 45%; web, 20%; flange, 35%. I have not found any simple rule for interpolation of sizes between extreme sections for intermediate ones. This, however, can receive more attention later.

Mr. J. D. HAWKS writes: There are some features of my suggested sections herewith sent that I would strenuously insist on retaining. There are other features that I would readily consent to modify. It will be noticed that the width of head in the 90 and 100-lb. sections is the same. I think it is as wide a head as could be used with safety in a northern climate, and think so from the experience of the Michigan Central many years ago with a wide-topped rail, and the difficulty they had by reason of the wheels leaving the track in snowy weather.

I have retained the thin head that we use on the Michigan Central on our 80-lb. rail for the 90 and 100-lb. sections. There would be no great objection to making the head somewhat thicker for the latter sections if it was considered advisable.

Mr. GEORGE S. MORISON says: The rail is adapted to the form of joint in most general use, which is the angle-plate joint, and also to lay on ties in accordance with the general American practice. The height of rail is made the same as the width of base.

The width between the parallel and vertical sides of the head has been made 2⅛ ins. and is kept uniform for all weights of rail. This is a radical departure from the usual practice of rail designs, but is regarded as a very important thing. The different weights of rail are determined by the amount of business which they are expected to carry, seldom by the character of the traffic which passes over them. The same wheels run on light and on heavy rail sections. If the weight is to be carried properly down the center line of each rail, the distance between that center line and the gage line must be kept constant. Furthermore, if the wear on wheels and rails is to approach uniformity, the wearing surface of the rails must be of uniform shape. The amount of metal in the head is 41½% of the total metal in the rail, which makes the variation in the cross section of the head for each 5 pounds weight of rail 0.204 sq. ins. As the only variable in the head is the height, this variation of weight corresponds to variation of height, 0.081 in. for each 5 lbs. weight of rail.

The sides of the web are made parallel. This arrangement is adopted to prevent using too thin metal for the center of the web in the lighter rails, and to prevent using too small a radius for the fillet connecting the web with the head in the heavier rails. The width of the web measured from out to out of the fillet is kept constant, and this width is fixed at 1 in. This leaves a width of ¾ in. on each side under the head, for the bearing of the angle plates, which is little enough.

Mr. E. T. D. MYERS writes: My endeavor has been to base my suggestions upon the recorded recommendations of a committee of the society, and also upon the deductions of those who have been close observers, whether as makers or users of rails. While these sections do not contemplate the use of base plates, I am nevertheless one of those who believe that better methods of increasing both the bearing of the rails, and their hold upon the ties, will, in the near future, come into use, and with them substantial modifications in the form of rails.

Mr. THOS. RODD writes: I send a little diagram showing approximately how the 80-lb. rail would wear down on a curve. The unit strains in compression, considering the rail as a beam, non-continuous, at 20-in. bearings, are given for the original section and for the reduced section, allowing in each case 40,000 lbs. as the extreme fiber strain. The little table subjoined gives the center breaking load of the original section and of the worn section, the depth of wear being the same in each case, and as shown in each section; and the allowance being also made for side wear as shown on the section, for curves, the extreme fiber strain being taken as 40,000 lbs. The supplemental drawing of 80-lb. section shows the graduation of the strains between the outermost fibers and neutral axis at center of span. In assuming the high extreme fiber strain of 40,000 lbs., it should be borne in mind that the less strained part tends to help the more strained part; furthermore, the stresses shown exist only at midspan, since they are dependent on the bending moment, which decreases from the middle toward the end of the span, and with it the intensity of the horizontal stress also, so that the strain varies not only in the vertical direction on both sides of the neutral axis, but also in the direction of the length of the rail.

ORIGINAL SECTION.		WORN SECTION.		
Weight.	Center breaking load.	Per cent. of head worn.	Center breaking load.	Per cent. of original strength remaining.
Lbs.	Lbs.		Lbs.	
50	43,200	35.0	29,800	69.0
60	52,700	33.8	38,100	72.3
70	68,300	31.8	51,200	75.0
80	80,800	30.1	60,600	75.0
90	93,600	32.9	78,900	84.3
100	111,400	28.0	98,000	88.0

Mr. A. M. WELLINGTON writes: The following dimensions are assumed by me as constants throughout the sections:

12-in. top radius, ¼-in. corner radius, Vertical sides, 1/16-in. lower corner radius.	Pursuant to recommendations of former Committee on Form of Rails and Wheels, and for the reasons stated in their report.

1 to 4 (14° 02′) angle of lower side of head with the horizontal, adopted instead of 13°, which is perhaps more usual, for the reason that it does not sensibly diminish the efficiency of the fish-plate bearing, while fish-plates are used, and gives a slightly better form of section if fish-plates are not used. I do not consider the difference of much importance, and should be ready to assent to 13° if preferred by a majority of the committee.

Of the Neck.—Quarter-inch fillet radii, as the best compromise between giving as good a fish-plate bearing as possible (requiring a short radius), and easing the transition between neck and head and base, which requires a long radius, but in my opinion not a very long one, when the neck is made fairly thick.

Vertical Sides.—In order that the thin metal furthest removed from the top and bottom masses may not cool too rapidly, the neck is made fairly thick for the same reason, and to avoid concentrating too much of the work done in rolling on the neck. If it be true, however, that the extra work done on these masses suffices to keep them hot enough, my impression is that these sections might be improved by removing some metal from the neck and adding it to the extremities of the base.

Of the Base.—1/16-in. corner radii, vertical sides. The lower corner of the base should not be sharp, as it tends to promote cutting. The upper corner should have some small rounding. There should be as much of a vertical face as possible to give bearing against spikes.

1 to 4 angle of top of base with horizontal. I adopt this partly to make it the same as the head (though there is no longer any special reason why the two should be alike).

Distribution of Metal.—I am satisfied that there is no real gain in life of rail, but rather loss, in putting more than 40% of the metal in the head; and that the neck should not be too thin. It might be well, however, to take 1% of the metal from the neck, and use it to thicken the extremities of the base.

Width of Base.—I assume this as the same as the base, in accordance with current practice, up to and including 80-lb. rails. Beyond that point it is not rational to design rail sections with a view to their resting directly on the tie, and if a base plate is used it seems better to retain a constant width of 5 ins. for all sections from 80 to 110 lbs., inclusive. Good rolling of the heavier sections is thus promoted.

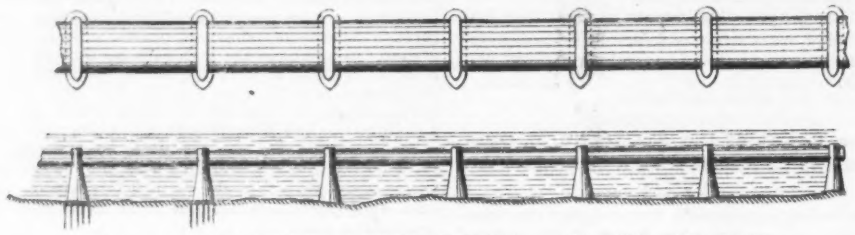
Width of Head. I believe this should be as wide as possible for all sections, and therefore that it should increase about in proportion with the height. It is desirable, on the other hand, to give some weight to the desirability of having all rail heads of the same width. With perfectly flat rail tops this would be quite important; with a 12-in. top radius, I believe it to be of very minor import-

ance, for the reason that a worn tread naturally wears to about a 12-in. radius for a width considerably wider than the widest rail head, and therefore fits well any rail-head not over 3 ins. wide, on the principle of the ball-and-socket joint. Only in very rare instances, I believe, could the variable width cause the load to come on the corners of the rails. I therefore adopt the following widths of rail heads:

Width of rail, lbs. per yd...	40	50	60	70	80	90	100	110
Width of head, ins.....	2⅛	2¼	2⅜	2½	2⅝	2¾	2⅞	3

A Subaqueous Viaduct.

Subaqueous viaducts have been suggested at various times and by various engineers for the crossing of navigable streams, and where the depth of the water or the character of the bottom material makes tunneling too costly or impossible. One of the practical difficulties that have interfered with the adoption of these plans is the prevention of corrosion in the metallic tube, exposed as it is to the action of sea water, in a position where renewal is practically impossible.



FIGS. 1, 2. SUBAQUEOUS VIADUCT—GENERAL ELEVATION AND PLAN.

The viaduct here described is the invention of Mr. FREDRIK E. STROM, a Swedish engineer of experience, and has been patented in the United States, under date of Oct. 28, 1890. In this design Mr. STROM utilizes the displacement of the water in supporting the dead and live load, as will be further described, and has so selected and arranged his materials as to guard against corrosion and secure a strong and substantial submerged tubular bridge.

Figs. 1 and 2 show an elevation and plan of a part of the submerged viaduct. After the bed of the stream to be crossed has been thoroughly surveyed and the character of the material fully ascertained. the foundation for the piers can be settled upon, This foundation will differ with the bed material. If rock is found the bottom would simply be leveled with concrete; if the ground is very soft it may be necessary to drive piles and cap with concrete or timber. But, as it will be seen later that the distributed load on the pier base is really very small in this class of structure, one of the great advantages is that in ordinary soil the chief requirements are a level bed and precaution against undermining.

The lower portion of the pier is itself a metallic caisson, to which a bottom may be attached if desired, and the sides extended above high water mark by a temporary iron caisson bolted to an angle provided on the inclined sides of the bottom portion of the pier. This caisson is built on the shore and towed out and sunk at the required site with concrete. As will be seen the temporary caisson is attached below what is to be the support of the bridge. This arrangement admits of the adjustment of this part to exact level and alignment after the pier has settled to a final bearing, with the greatest load that will ever be put upon it, viz., the concrete inside of it.

The length of each span here proposed is 400 ft. between pier centers. This length is selected for convenience in handling and to meet conditions to be further described. This tubular span is built complete on the shore, with the ends securely closed with temporary bulk heads, and is then towed out

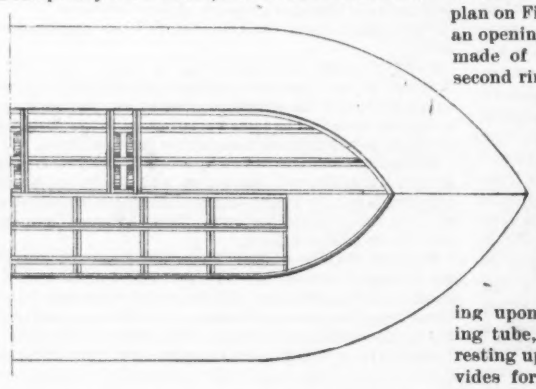


Fig. 3. Plan showing Half Pier at Bridge Seat and at Top of Pier.

suspended between four vessels. In some cases several of these tubes may be joined together before launching.

As shown in the cut, the piers are built with the top portion or roof removed, so that the tube can be lowered into place upon them, and propelled forward to a joint with the tube in place by another device that is now being patented. This pier roof, made of plates and girders, is afterward firmly bolted by divers over the tube, and is then covered with concrete.

The viaduct tube itself is built as follows: There is first an inner skin of ½-in. steel plate, riveted and calked so as to be water tight. This is connected with an outer wall of ⅜-in. steel, at a distance fixed by the span and number of tracks, by radial girders cutting the annular space into any desired number of compartments. These compartments are filled with neat Portland cement and concrete, which serves the double purpose of ballast, and to preserve the metal against corrosive action.

The original plan called for further outer shells of prepared wood and copper; but Mr. STROM believes that this extra precaution is unnecessary, provided the steel plates are properly treated by tar compounds before using. The preservative qualities of cement applied to metal are well known, and have been well proven in the use of cement for years past in the bottoms of iron ships.

It will be noticed that the cellular tube, resulting from the arrangement of parts here described, is one of the strongest possible forms of construction that could be used. The inventor claims that the inner shell can be replaced when required; and that if the outer shell should in the course of indefinite time corrode sufficiently to expose the ends of the radial girders, the further attack upon these would be extremely slow. The concrete in itself forms voussoirs.

A very essential feature in the device is the joint between any two tubular sections, shown in the plan on Fig. 6. A series of clamps extend through an opening left in the outer ring. These clamps are made of two parallel plates of iron, bolted to the second ring, and reinforced at the inner faces at the ends so as to form a latch. In the corresponding compartments on the other tube are single plates provided with a wedge-shaped catch. On each pier are a series of rollers which are to be used in this connection of sections, or in launching a series of tube sections connected together, after the fashion of erecting continuous girders in common use in France. In this case the fixed tube is already resting upon two of these rollers; and the approaching tube, when a joint is to be made, also must be resting upon the other two. This arrangement provides for the approach on a proper level; and the fact that a two- or four-track viaduct is much broader than it is high does away with any trouble from twisting out of line. When the tubes meet, a compressible rubber or other gasket provides a reasonably fair water-tight joint, and permanent connection is made afterward by inside flanges or cover plates. Certain devices, not here shown, can be provided to compensate for expansion and contraction. But this movement, 30 ft. below the water surface, would be very slight. In the North River, for exam ple, calculation shows that it would be about ¾ in. in 1,000 ft.

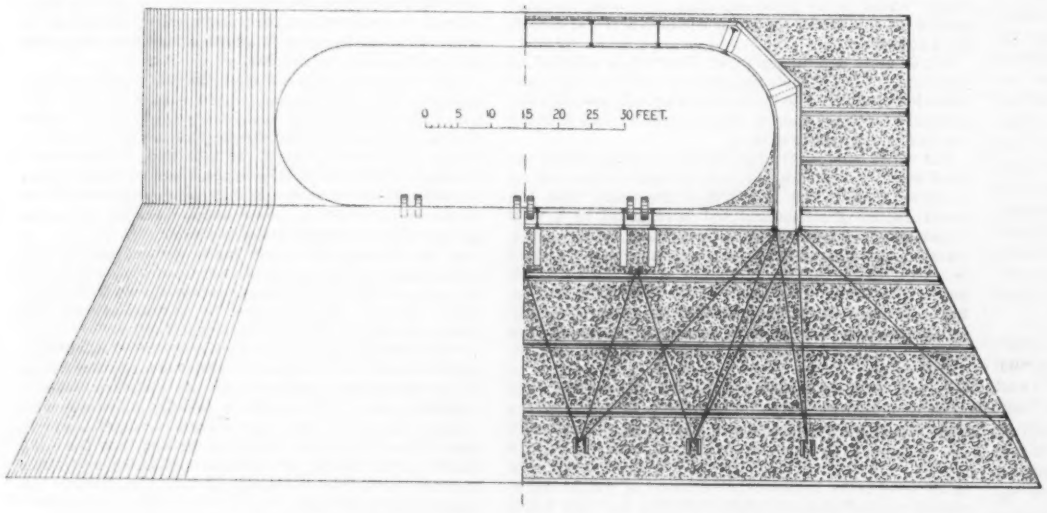


FIG. 4. HALF LONGITUDINAL SECTION AND HALF SIDE VIEW.

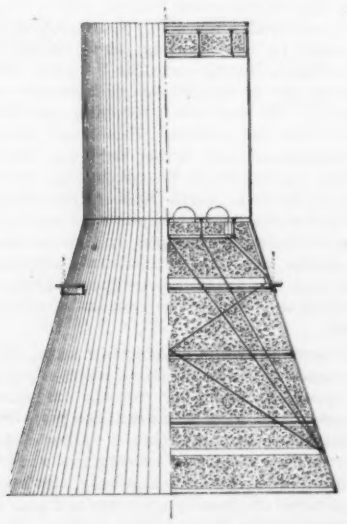


FIG. 5. HALF CROSS SECTION AND HALF END VIEW.

From actual bills of material and calculations for displacement furnished by Mr. STROM, the following table is prepared, showing the elements for a one- to four-track viaduct. It should be stated here that a single-track viaduct on this plan would be inadvisable, as two such circular submerged bridges would cost about as much as a four-track connected viaduct, and be more troublesome to handle.

WEIGHTS AND BUOYANCY PER LINEAL FOOT OF TUBE FOR ONE- TO FOUR-TRACK VIADUCTS.

Per lin ft. of tube.	Pounds. One track.	Two tracks	Three tracks.	Four tracks.
Buoyancy	28,495	51,810	75,776	99,666
Weight of metal	5,343	9,722	13,731	17,740
Weight of concrete in tube	20,172	36,162	53,136	70,003
Total weight of unloaded tube	25,515	45,884	66,867	87,743
Net buoyancy of unloaded tube	2,980	5,926	8,809	11,923
Estimated weight of train.	3,000	6,000	9,000	12,000
Concrete in pier	8,384	15,744	22,755	30,135
Displacement by tube; cu. ft.	452.3	822.4	1,202	1,582

It will be noticed from an inspection of the above table that the inventor has so arranged his weights, taken in connection with the displacement or buoyancy of the tube, that the net buoyancy per lineal foot of the unloaded tube alone is slightly less than the estimated train load. In other words, the strains in the unloaded tube are just the reverse of those in an unloaded bridge, and the weight of the piers acting as anchors is called into play to keep the tube from rising. When the load of the train comes upon the tube this load slightly exceeds the buoyant tendency, and, theoretically at least, the strain upon the tube is then only that due to the slight difference between these two elements.

The piers, in fact, are not piers at all in the common acceptation of the term. They are practically anchors, but so arranged as to keep the tubes in proper alignment and to resist the floating tendency in the unloaded tube. The greatest strain upon the tube is when the rolling load is absent, and, as seen, the presence of this rolling load is figured to just overcome the buoyancy per lineal foot. As will be seen, with the extended pier base made necessary by the form of construction, the load upon the base is practically only that due to the weight of the pier itself, and, in a four-track viaduct, as designed, amounts to about 200 lbs. per sq. ft. The tube itself is supported by the water through every lineal foot, and the section is common throughout, from end to end.

During construction it is proposed to keep the tube empty during the whole operation; and in case of an accident after the bridge is in place the tight vertical partitions are depended upon to prevent more than one or at the most two sections of the tunnel being flooded at a time. But the filling of the entire tube with water would materially alter the conditions outlined above; and against this believed-to-be remote contingency the inventor has taken precautions by proportioning his 400-ft. span so that it would support itself on piers *in the air*. As showing what this contingency is it may be stated that the weight of water per lineal foot in all four sections of a four-track viaduct would be about 48,000 lbs. The buoyancy of the tube would be reduced then to the mere displacement of the shell and partitions, or to 51,666 lbs. This element is met by the weight per lineal foot of the metal and concrete, or 87,743 lbs.; hence, in this case a load of about 36,000 lbs. per lin. ft. would have to be transferred to the two piers. As no rolling load is possible with the tube full of water, this submerged bridge, to meet this remote contingency, must only be able to sustain a little more than one-third its own dead weight, a feature which a bridge builder will appreciate as compared with the ordinary structure in the open air.

For further information we would refer our readers to Mr. FREDERIC STROM, 250 Union St., Brooklyn, N. Y., and Mr. JOHN A. HILLIKER, 55 South Fourth St., Minneapolis, Minn.

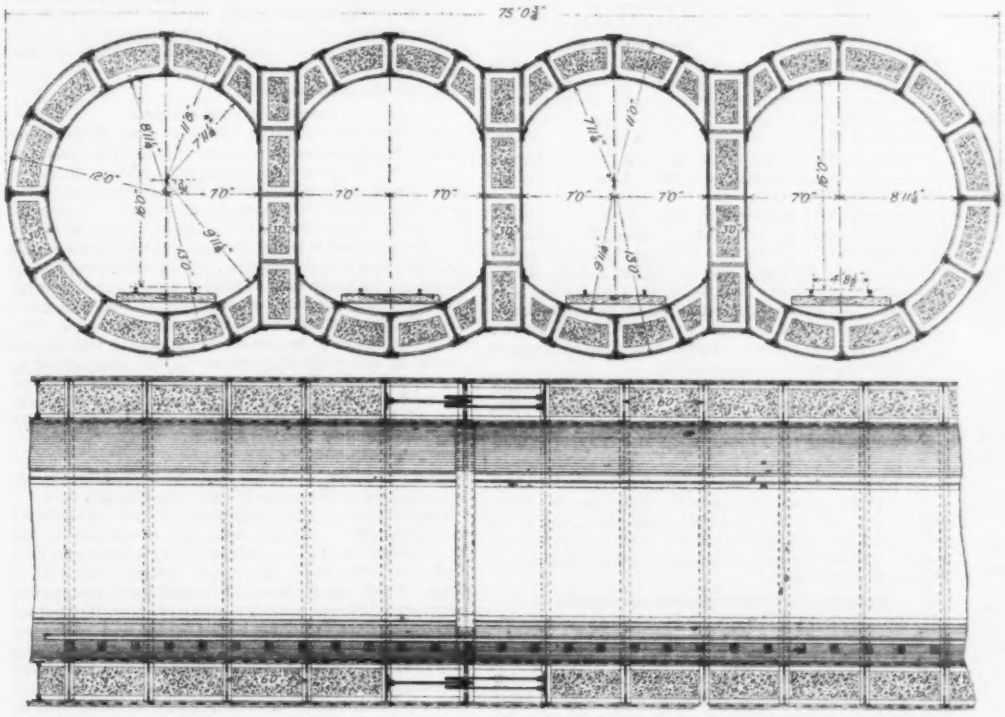


FIG. 6. SUBAQUEOUS VIADUCT: CROSS AND LONGITUDINAL SECTIONS, SHOWING JOINT.

Holding Power of Drift Bolts.

Below we present a summary of three series of experiments on the holding power of drift bolts. Curiously, there is very little information in engineering literature on this subject, and our object in this article is to present what little information there is in such a form as to make it more useful.

U. S. Government Experiments.—These experiments were made under the direction of General WEITZAL by Assistant U. S. Engineers A. NOBLE and C. P. GILBERT, in 1874-1877, and were published by Colonel O. M. POE in his report to the Chief of Engineers for 1884. This series was very extensive, but the valuable results obtained are robbed of much of their value by the lack (in the original publication) of suitable comparisons and conclusions.

The mean of from 150 to 200 experiments with round and square bolts, both ragged and smooth, in different sized holes shows that the resistance after having been driven seven months is 10% greater than the resistance immediately after driving, the different sizes and forms being strikingly uniform. The mean of 150 experiments under various conditions shows that the resistance to being drawn in the direction which it was driven is only 60% of its resistance to being drawn in the opposite direction; that is to say, the resistance to being drawn *through* is only 60% of that to being drawn *back*. The mean of 50 experiments shows that smooth rods have a greater holding power, both to being drawn through and also to being drawn back, than ragged ones, a "moderate ragging" reducing the resistance a little more than 25% and on "excessive ragging" reducing the holding power more than 50%.

Concerning the best relation between the diameter of the bolt and that of the hole, one series of 60 experiments, shows that the holding power of a 1-in round rod in a $\frac{1}{16}$ hole is greater than in either a $\frac{1}{8}$ or in a $\frac{3}{16}$ hole, the resistance in the $\frac{3}{16}$ hole being 98%, in the $\frac{1}{8}$, 90% of that in the $\frac{1}{16}$ hole. On the other hand, another series of 35 experiments makes the resistance in a $\frac{1}{16}$ hole greater than in a $\frac{1}{8}$ or a $\frac{1}{4}$, the first two being practically the same and the last being only 85% of the first. However, the difference between the two series is not material, considering the nature of the experiments. For a $\frac{5}{8}$-in. round bolt, four experiments on each size seem to prove that the holding power in a $\frac{1}{16}$ hole is about one-quarter greater than in a $\frac{3}{8}$ or a $\frac{1}{4}$ hole. For a 1-in. square bolt the holding power in a $\frac{1}{8}$ hole is only a trifle greater than in a $\frac{1}{4}$ and about 20% greater than in a $\frac{3}{8}$ hole, as deduced from 20 to 40 experiments for each size of hole.

The holding power of a 1-in. square bolt in a $\frac{1}{16}$ hole was practically the same as for a 1-in. round rod in a $\frac{1}{16}$-in. hole. There is 25% more metal in the square drift bolt, while more labor is required to bore a $\frac{1}{16}$-in. hole than a $\frac{1}{16}$-in. one; therefore, the round drift bolt is at least 25% more efficient per pound of metal than the square one.

The holding power of a 1-in. round bolt in a $\frac{3}{8}$-in. hole in white pine, when drawn back immediately after driving, is a trifle over 10,000 lbs. per linear foot of bolt, a mean of 42 experiments on 7 pieces of timber. Twelve experiments on 3 sticks of Norway pine, under conditions similar to the preceding, gave 9,000 lbs. per linear foot of bolt. Experiments upon 4 sticks of hemlock seem to show that the resistance is practically the same as white pine.

One-inch round screw bolts were screwed into $\frac{3}{8}$, $\frac{1}{4}$, and $\frac{5}{16}$-in. holes and immediately drawn back, the result being that there was but little difference for the different-sized holes. Half of the bolts had 8 threads to the inch and half had 12, the latter giving a very little the greater resistance. The resistance for the screw bolts was about 50% more than the maximum resistance of the plain round rods.

The report says: "Two classes of blunt points were used: Long, blunt points, tapered back for a distance of 1½ to 2 ins. and reduced to a round section, on square as well as round bolts, with a diameter less than that of the hole into which it was driven. They were pointed hot. Short, blunt points were reduced in size at an angle of about 45° by cold hammering, the point of the square bolt remaining square, with rounded corners, the intention being more to remove all cutting edges from the point than to reduce it much in size or change the square sections to round." The experiments were not so arranged as to make it possible to draw any reliable conclusion as to the relative merits of the two forms of points; but, if the experiments show anything in this respect, it is that the resistance of bolts having "long, blunt points" is about 10% more than those having "short, blunt points."

Brooklyn Bridge Experiments.—Experiments made in connection with the construction of the East River bridge by Mr. F. COLLINGWOOD and Col. PAINE, and communicated by the former, gave a holding power of 12,000 los. per linear foot of bolt for a 1-in. round rod driven into a $\frac{13}{16}$-in. hole in first quality Georgia pine, and a resistance of 15,000 lbs. in a $\frac{1}{16}$-in. hole. It was found that in lighter timber containing less pitch the holding power was about 20% *less*; and in very dense wood, containing *more* pitch, about 10% more.

University of Illinois Experiments.—A third series of experiments was made by Mr. J. B. TSCHARNER in the testing laboratory of the University of Illinois, and published in full in "No. 4 Selected Papers of the

Civil Engineers' Club of the University of Illinois.' According to these experiments, the average holding power of a 1-in. round rod driven into a $\frac{15}{16}$-in. hole in pine, perpendicular to the grain, is 6,000 lbs. per linear foot; and under the same conditions the holding power in oak is 15,000 lbs. per linear foot. The holding power of the bolt driven parallel to the grain is almost exactly half as much as when driven perpendicular to the grain. If the holding power of a 1-in. rod in a $\frac{15}{16}$-in. hole be designated as 1, the holding power in a $\frac{1}{16}$-in. hole is 1.69; in a $\frac{1}{8}$-in. hole, 2.13; and in a $\frac{1}{4}$-in. hole, 1.09. The holding power decreases very rapidly as the bolt is withdrawn.

The Properties, Uses and Processes of Production of Aluminum.*

POPULAR FALLACIES CONCERNING ALUMINUM.

The metal aluminum has certainly not been "damned by faint praise." On the contrary, from my experience as the president of an aluminum manufacturing company which has been endeavoring for the past two years and over to sell the pure metals in the markets, and to introduce it into the arts and manufactures of the country, I have to state to you my conviction that one of the two chief difficulties which have been encountered, and which to-day retards and restricts the use of the metal, is the extravagant, erroneous, and in many cases mischievously misleading claims which have been made as to the properties of the metal. These have received wide circulation, not only through the daily newspapers, but, I am sorry to add, through many technical and scientific journals as well. The other difficulty is the almost equally widespread, and, so far, equally extravagant and misleading claims, by inventors, of processes for the manufacture of aluminum at remarkably low prices.

I shall endeavor in this lecture to correct some of these fallacies, as to the properties of the metal, and also, in describing the minerals in which the metal occurs and the methods of reduction which have been practiced, to explain the principal difficulties which have thus far been encountered. I shall also venture a prophecy as to the success of cheaper methods of manufacture of aluminum in the future.

PURE AND IMPURE ALUMINUM.

Some of the erroneous statements regarding aluminum have had their origin in the fact that commercial aluminum is never chemically pure, and that until within the past six years nearly all the aluminum of which the properties had been described had at least 1%—in many cases 6% or 8%—of impurities. These materially altered the characteristics from those of the purer metal with not over 2%, or at most 3%, of impurities which is sold in the markets to-day.

The impurities almost always found in aluminum are silicon and iron. These two impurities are almost the only ones found in the electrolytically deposited metal, considerable amounts of any others being accidental and due to carelessness in manufacture. In fact, I hope to be able in the near future to say that the impurity consists of the single one, silicon, as we have already made many hundred pounds of aluminum, with only a trace of iron present, and tons of metal with less than $\frac{1}{10}$ of 1% of iron.

The silicon present in aluminum exists in two forms, one seemingly combined with the aluminum, as combined carbon exists in white pig iron, and the other in an allotropic graphitoidal modification. These two forms of silicon seem to exert considerably different effects by their presence in the aluminum; the combined form of the element rendering the metal much harder than the graphitoidal variety. The combined silicon ordinarily preponderates, being from 55% to 80% of the total silicon in the average metal between 98% and 99% pure made by the Pittsburg Reduction Co.

For many purposes, the purest aluminum cannot be so advantageously used as that containing 3% or even 4% of impurity, as the pure metal is very soft and not so strong as the less pure metal. It is only where extreme malleability, ductility, sonorousness, or non-corrodibility is required that the purest metal should be chosen. We shall probably find that for most purposes a small percentage of other elements than silicon and iron can be advantageously added to produce hardness, rigidity and strength; constituents that will not detract from the non-corrodibility of the metal as much as do these natural impurities that come from the ore and apparatus—additions that will give the aluminum a better color and greater strength and hardness, with proportionately less sacrifice of malleability, ductility, etc.

COLOR OF ALUMINUM.

Pure aluminum is white, with a decided bluish tint. This becomes much more marked upon exposure, when a thin film of white oxide on its surface prevents further tarnishing from the air, but seems to give by contrast to the metal as a background an enhanced bluish tint. I am sorry to hear my good wife report this color as giving a decidedly pewtery appearance to the spoons and forks which we have had in almost constant daily use for comparison with silver for the past year and a half. The oxide which gives this decided blue tint may be removed by immersion in a dilute solution of hydrofluoric acid, and then rubbing with chamois skins aturated with petroleum.

No one should expect the color of silver in aluminum—especially of silver of the markets, which is given a decided yellow tinge with copper—for the natural color of aluminum is different, and the addition of copper, although making the metal a yellower white, does not entirely change its natural bluish-white tint. The addition of small percentages of silver, chromium, manganese, wolfrom, or titanium, undoubtedly improves the color of aluminum, making it nearer to that of silver.

ACTION OF HEAT ON ALUMINUM.

Aluminum melts at about 1,300°, but becomes pasty at a temperature of about 1,000°, and indeed loses its tensile strength and very much of its rigidity at a temperature of 400° to 500°, although this loss of strength is only while the metal is kept at the high temperature. It serves as an annealing operation, and reduces permanently only the higher tensile strength produced by cold rolling or otherwise cold working the metal. Aluminum does not volatilize at any temperature ordinarily produced by the combustion of carbon, even though the high temperature be kept up for a considerable number of hours. It, however, absorbs a very large amount of occluded gases under such treatment. In the high temperature of the electric furnace, it is claimed that there is considerable volatilization of aluminum, and that small buttons of the metal have been found in and on the linings of the furnace. The Cowles people, however, have never been enabled to collect and commercially produce pure aluminum by their electric furnace, for the reason that the metal rapidly oxidizes into alumina. It has only been by protecting the reduced metal with an alloy of either iron or copper that they have succeeded at all in retaining the reduced aluminum.

Under heat, the coefficient of linear expansion of $\frac{5}{8}$ in. round aluminum rods of 98.50% purity is .0000206 per degree centigrade between the freezing and boiling points of water; that of iron being .0000122, tin .0000217, copper .000017182. Multiplying this factor by $\frac{5}{9}$ to reduce it to the Fahrenheit scale we have .0000115, or an expansion of .00115 ft. on 100 ft. of aluminum raised 1° Fahr. from 32°. It is probable that the coefficient of expansion of alloys of aluminum is very close to that of tin.

The specific heat of aluminum is 0.2143, water being taken as 1. The metal follows the general rule of metals, its specific heat being inversely as the atomic weight.

By the method of WEIDERMANN and FRANZ, taking silver as 100 and copper as 73.6, unannealed aluminum of 98.50% purity has a coefficient of thermal conductivity of 37.96; and the same wire annealed 38.87. In the same scale, tin has a heat conductivity of only 14.50, iron 11.90, steel 11.60, and lead 8.50. From this it is evident that, next to silver, copper and gold, soft annealed aluminum is the best conductor of heat.

ELECTRICAL PROPERTIES OF ALUMINUM.

It also stands next to silver, copper and gold, as a conductor of electricity. One yard of annealed aluminum wire of 98.50% purity, .0325 ins. in diameter, at 14° Cent., has .05484 of an ohm resistance, a yard of pure copper wire of same section having a resistance of .0315 of an ohm. The electrical conductivity of silver being taken at 100 and copper at 90, pure annealed aluminum has an electrical conductivity of about 50. These facts, taken into consideration with the comparative lightness of the metal as compared with silver, gold and copper, are already leading to a quite extensive use of aluminum.

Pure aluminum, and indeed the electrolytically made commercial aluminum, with less than $\frac{1}{2}$ of 1% iron, regularly put upon the market to-day, exhibits no appreciable polarity. Such metal has many advantages for compass boxes, or for cases for electrical apparatus where non-magnetic properties are desired.

MECHANICAL PROPERTIES OF ALUMINUM.

The fracture of aluminum shows ordinarily hexagonal crystals, although the pure metal is very tough, and in breaking by bending backward and forward, often appears distinctly fibrous in fracture. The lack of rigidity and hardness which the metal exhibits is a serious obstacle to its adaptability for many purposes, although both stiffness and hardness are very much increased by the addition of a few per cent. of impurities or alloy, and are especially improved by cold hammering, cold rolling, drop forging or the like. For castings for surveying instruments, pure aluminum would be especially adapted were it not for its softness and lack of rigidity. It can be safely stated as a general rule that the purer the aluminum, the softer and less rigid it is.

Pure aluminum is, when properly treated, a very malleable and ductile metal. It can readily be rolled into sheets $\frac{1}{10}$ to $\frac{1}{200}$ in. thick, or be beaten into leaf nearly as thin as gold leaf, or be drawn into the finest of wire. Pure aluminum stands third in the order of malleability, being exceeded only by gold and silver; and in the order of ductility, seventh, being exceeded by gold, silver, platinum iron, softest steel and copper. Both malleability and ductility are greatly impaired by the presence of the two common impurities, silicon and iron.

Aluminum can be rolled or hammered cold, but the metal is most malleable at between 200° and 300° Fahr., and should be heated to this point for rolling or breaking down from the ingot to the best advantage. Considerable power is required, fully as much as for hot rolling of hard steel of similar section, although not nearly as much draft can be placed upon the rolls as in hot rolling hard steel. Like silver and gold, aluminum stiffens up remarkably by working it, increasing a great deal its hardness and its tensile strength and decreasing its malleability and ductility; it requires to be frequently annealed. As compared with cold rolling soft steel, it has been found practicable to give aluminum about the same reduction in each pass as the steel; the aluminum requiring on the average five annealings where the steel requires but three.

By hardening the metal by rolling, forging, drop-forging, stamping, drawing, etc., it may be turned out very rigid, and will then answer excellently for purposes, where the annealed metal would be entirely too soft, too weak, or lacking in rigidity or elasticity. Especially is this true of aluminum alloyed with a few per cent. of titanium, copper, iron, silicon, or the like. The alloys do not show their increased hardness to anything like their maximum extent in castings, and I am sorry to say not at all in proportion to the increased brittleness. But when these castings are drop-forged, rolled, hammered, or drawn down, with only sufficiently frequent annealings to prevent the metal from cracking, the increased hardness shows up in a remarkable degree. These properties have already become not only the subject of a considerable number of letters patent, but also of established uses in the arts, and will in future add enormously to the applicability of the metal.

ANNEALING ALUMINUM.

To anneal aluminum, a low and even temperature should be maintained in the muffle—just such a temperature as will show an even, red heat in a piece of iron or steel placed in the muffle, when viewed at twilight or on a dark day. The aluminum itself, however, should not appear at all red at this temperature. A ready test of this temperature is that the metal has been heated enough to char the end of a pine stick, which will leave a black mark on the plate as it is drawn across it. When the metal has acquired this temperature, it should be taken from the furnace and allowed to cool gradually. Very thin sections may be annealed by placing into boiling water and either allowing to cool with the water or taking out to cool gradually. Of course, it is possible to anneal to any degree by lowering the temperature to which the metal is heated below that specified by means of suitable appliances.

WELDING AND SOLDERING ALUMINUM.

Aluminum can be easily and readily welded by the apparatus of the Thomson Electric Welding Co.

Until very lately the lack of methods for successfully soldering and hardening aluminum were two of the greatest drawbacks to its introduction for many purposes. I am glad to be able to say to you, however, that both of these difficulties, I believe, have lately been successfully overcome. I have already outlined to you the method of alloying pure aluminum with a few per cent. of hardening metal and cold rolling or otherwise working as being ways out of the difficulty of its softness. The exhibitions of soldered metal will show you that aluminum can now be successfully soldered. These results were obtained by the use of the blow-pipe and with ordinary hard or soft solder, or with pure zinc, or with an alloy of zinc and aluminum, as the soldering metal. The novelty, which has just been covered by letters patent, is in the soldering salt, which allows the solder to flow freely on the surfaces to be united.

CASTING ALUMINUM.

Sound castings of aluminum can be readily made in dry sand molds. The aluminum should not be heated very much beyond the melting point; otherwise it seems to absorb gases, which remain in the metal, preventing sound castings. In small quantities the metal can be best melted in plumbago crucibles; but in large quantities it can be more economically melted in a reverberatory furnace with alumina or magnesia brick sides and alumina bottom. The furnace should have a tap hole for drawing off the liquid metal into carbon-lined ladles. In no case need the metal be covered with a flux to assist in the fusion or to form a covering of slag. In fact, owing to the metal's lightness, the presence of any flux will tend to unsoundness, due to particles of it becoming entangled in the castings, while impurities may perhaps be added to the metal by the action of the flux on the lining of the melting vessel. The molten metals flows readily, and not much larger gates are needed than for brass. The shrinkage of $\frac{5}{16}$ in. per ft., which aluminum has, is considerably more than that of brass, which is about $\frac{3}{16}$ in. per ft. The shrinkage can be reckoned ordinarily as about 2.26% of the length of the mold. Wooden patterns made for brass, to give equivalent castings of aluminum, should be given 3 or 4 thick coatings of shellac.

RESISTANCE OF ALUMINUM TO CORROSION.

As to the corrodibility of aluminum, a great deal has been printed that is not correct. In the first place, aluminum is acted upon by the atmosphere, especially by

* A lecture by ALFRED E. HUNT, of Pittsburg, Pa., before the Boston Society of Arts on Feb. 12.

moist atmosphere, and more especially still by moist salt atmosphere. The metal becomes covered by a very thin, almost imponderable, coating of oxide on the surface exposed to the atmosphere, which seems to protect it from further oxidation. This coating is so thin as often to hardly interfere with any polish, and it does not materially change the weight of the metal. It does, however, increase the bluish tint of the metal, as before explained, and gives it a leady color. As compared with most metals, pure aluminum under ordinary circumstances withstands the action of wind and weather exceedingly well; and many uses to which the metal is now being successfully applied are based upon this fact. The presence of silicon in aluminum materially detracts from its power to withstand corrosion due to atmospheric influences. Metal with 4 or 5% of silicon very soon collects a thick coating of oxide upon it if much exposed. The fact that pure aluminum is not acted upon by boiling water or by steam has led to its use as a packing or gasket in steam connections, where lead and similar metals have been rapidly cut out (especially where the water contained notable amounts of sulphur acids), as in parts of steam and water pumps and difficult steam joints. The New York Steam Co. have found it a very satisfactory way of packing their leaky steam joints to put in first a layer of aluminum wire, without attempting to calk it much, adding another ring of the softer but easier corroded lead on the outside, which can be calked into place, making the joint steam-tight.

Aluminum containing sodium is rapidly acted upon by hot water, the sodium being eaten out, leaving the aluminum spongy and porous. Aluminum is unaffected by either concentrated sulphuric or nitric acids. Unfortunately, however, these commercial acids almost always contain some little hydrochloric acid, which rapidly corrodes the aluminum, the chloride of aluminum first formed being changed into sulphate or nitrate, the free hydrochloric again acting more violently as it attacks the metal in a nascent state.

Aluminum is not acted upon by sulphuretted hydrogen, carbonic acid, or carbonic oxide gases; but the metal in a melted condition absorbs a large quantity of these gases, quite a portion of which is again excluded when the metal cools. Enough is left in the case of the sulphide to emit strong odors of the sulphuretted hydrogen which has been occluded and imprisoned in the metal in cooling. This fact is a strong obstacle to a sulphide method of reduction of the metal, where the sulphuretted hydrogen evolved would strongly impregnate the metal for a long time, even after several meltings.

ALUMINUM FOR CULINARY AND SURGICAL PURPOSES.

Pure aluminum has neither taste nor odor, nor is it corroded by any substances ordinarily used in culinary operations, and it seems therefore especially adapted for cooking utensils. For spoons, forks, and large dishes the metal also is useful, although its color can be improved and the metal made more rigid by a slight addition of copper.

Aluminum is less acted upon than is tin or copper or silver by salt water, and even by such solutions in vinegar as the metal is liable to be subjected to in ordinary culinary vessels. The salts of tin or copper thus dissolved are very poisonous; but not only are the aluminum salts that are formed less in amount, but the acetate of aluminum formed resolves itself on boiling into either an insoluble sub-acetate or into pure alumina, neither salt having either taste or injurious toxic action. For these reasons, quite surely aluminum will have a large future for cooking utensils. A cooking skillet of aluminum has been in service for a year in my own household.

Aluminum is found to withstand the action of organic secretions better even than silver, and for many forms of surgical instruments, tracheometer tubes, suture wires, and the like, and for forms for holding false teeth, the metal is already receiving very wide use. Many surgeons are having their instrument cases made of aluminum, it having the advantage that they can safely be washed clean with antiseptic solutions. It may be well for me to say here, however, that perspiration in handling polished aluminum does tarnish the metal, and that aluminum, like other metals, cannot retain a high polish with frequent handling. The natural acid solvent for aluminum is hydrochloric acid. Solutions of the caustic alkalies, chlorine, bromine, iodine, and fluorine rapidly corrode aluminum. Ammonia gas has very little action on the metal, except to turn it a gray color. Strong aqua-ammonia has a slight solvent action upon it.

OTHER PHYSICAL PROPERTIES OF THE METAL.

The specific gravity of aluminum, of course, is one of its most striking properties—a property on which many brilliant "castles in the air" have been built. It runs from 2.56 to 2.70; structural steel is 2.95 times as heavy, copper 3.60 times, ordinary high brass 3.45 times, nickel 3.50 times, silver 4 times, lead 4.80 times, gold 7.70 times, and platinum 8.60 times as heavy. Many uses have been suggested for the metal because of its lightness; one is for the entire framework of air ships. Now as there are many strong woods which have a specific gravity below 1, and are, therefore, about one-third the weight of aluminum; and as woods can be selected that will by no means require three times the section of aluminum to give equal strength for frames, I do not quite understand where the applicability of aluminum for this purpose comes in. Of course, in many cases a much thinner sheet or smaller section of aluminum could be used than of wood; but for purposes where rigidity as well as lightness is required, the parts of air ships could be made much better of wood than of aluminum. I will confess that as aluminum is a favorite metal of mine, I am loth to see it subjected to the rude falls to which I fear it will be endangered if attempts are made to build air ships of it.

Pure aluminum is very sonorous and varying qualities of sound are given by its different alloys. Unfortunately, just the right shape for an aluminum bell has not yet been discovered. The ordinary forms give out anything but an agreeable sound.

THE STRENGTH OF ALUMINUM.

Cast aluminum has about the ultimate strength of cast iron in tension, but under compression it is comparatively weak.

The following table gives the average results of many tests of aluminum, having about the following composition: Aluminum, 97 to 99%; silicon graphitic, 0.10 to 1%; silicon, combined, 0.90 to 2.80%; iron, 0.04 to 0.20%.

Tension tests.	Castings.	Sheet.	Wire.	Bars.
Elastic limit per sq. in., lbs.	6,500	12,000	16,000 to 30,000	14 000
Ultimate strength per sq. in., lbs.	15,000	24,000	30,000 to 65,000	28,000
Reduction of area.	15%	35%	60%	40%

Compression tests (in cylinders with length twice the diameter):

Elastic limit per sq. in. ..... 3,500 lbs.
Ultimate strength per sq. in. ..... 12,000 lbs.

The modulus of elasticity of cast aluminum is about 11 million; cold drawn aluminum wire about 19 million; aluminum sheets, about 13 million.

Under transverse test pure aluminum is not a very rigid metal. An inch square bar of good cast iron, supported on knife edges 4 ft. 6 ins. apart and loaded in center, will readily stand 500 lbs. without a deflection of over 2 ins. A similar bar of aluminum would deflect over 2 ins. with a weight of 250 lbs., although the aluminum bar would bend nearly double before breaking, while the cast-iron bar will ordinarily break before the deflection has gone very much beyond 2 ins. Aluminum to withstand strains, and especially to have good elasticity, should be alloyed with a few per cent. of impurities and cold rolled, or otherwise worked cold. In this way it can be made to be nearly as strong and elastic as mild steel, section for section, and weight for weight will be much more rigid.

ALLOYS OF ALUMINUM AND COPPER.

Aluminum and copper form two series of valuable alloys; the aluminum bronzes, ranging from 2% to 12% aluminum with copper, and the copper hardened aluminum series, with from 2% to perhaps 15% of copper with the aluminum. The aluminum bronze series are already beginning to assume an important position in the arts, and I believe will very largely replace brass and other bronzes, and for some purposes take the place of steel for structural purposes. By adding 8% to 12% of aluminum to copper, we obtain one of the densest, finest-grained, and strongest metals known—a metal having a remarkably good ductility as compared with its tensile strength. A 10% bronze can readily and uniformly be made in forged bars, with 100,000 lbs. per sq. in. tensile strength, with 60,000 lbs. elastic limit per sq. in., and with at least 10% elongation in 8 ins., and aluminum bronzes can be made to meet a specification of even 130,000 lbs. per sq in. and 5% elongation in 8 ins. Such bronzes have a specific gravity of about 7.50, and are of a light yellow color. The 5% to 7% aluminum bronzes have from 8.30 to 8 specific gravity and a handsome yellow color. They readily give 70,000 to 80,000 lbs. per sq. in. tensile strength, with over 30% elongation in 8 ins. and with an elastic limit of over 40,000 lbs. per sq. in. It will probably be alloys of the latter character that will be most used, especially for marine work. The fact that 5% to 7% bronzes can be rolled or hammered at a red heat, proper precautions which can readily be secured being taken, will add greatly to their value. Metal of this character can be worked in almost every way that steel can, and has greater combined strength and ductility and much greater power to withstand corrosion. By far the best results have been obtained by using the purest aluminum and purest copper. The presence of silicon in aluminum alloys makes a harder bronze, but one of much less comparative ductility and malleability. The presence of iron weakens and very seriously lessens the value of bronze. Tin also is disadvantageous. The presence of zinc in the aluminum bronze is not so deleterious; in fact, it makes the best aluminum brasses much better than those having tin in them.

The Cowles and Heroult people, who by their methods manufacture aluminum bronze by direct reduction, have claimed that the bronze directly reduced was more homogeneous and better than that made by melting together copper and pure aluminum. Careful experiments made in this matter, however, have failed to show this claim to be true. From my experience, I entirely agree with Prof. RICHARDS, who, in his excellent work, says: "Two specimens containing nothing but aluminum and copper in like proportions will be identical, no matter how they are produced." As it is far easier, and at present cheaper, to produce a bronze with small impurities of iron and silicon by using pure aluminum of less than 2% of these impurities, which with pure copper will give less than ½ of 1% impurity in the bronze, the advantage is certainly on the side of the use of pure aluminum, melting it with pure copper, so far as quality is concerned.

The aluminum in bronzes lowers the melting point of the copper at least 100° or 200°. The melting point of 10% aluminum bronze is somewhere in the neighborhood of 1,700° Fahr.

WORKING ALUMINUM BRONZE.

Aluminum bronze is among the hardest of the bronzes and hardens upon cold working considerably. This hardness, however, can readily be lowered by annealing at a red heat and plunging into cold water. Aluminum bronze can readily be tooled in a lathe, and the chips cut clean and smooth and long, and do not clog the tool. Aluminum bronze is a remarkably rigid metal under transverse strain, being much more rigid than ordinary brass, or even gun bronze. Under compression its strength, although rather low in elastic limit compared to its ultimate compressive strength, is still much higher than that of any of the other bronzes, and there is a long period of gradual compression before finally giving way, making it peculiarly a safe metal under compression.

Aluminum bronze has excellent anti-friction qualities, owing to its fine grain texture and peculiar smooth and unctious though hard surface, which resists abrasion remarkably. Attention has already been called to the anti-corrosive qualities of aluminum bronze; and as its electrical conductivity is better than that of brass, it is peculiarly well adapted for commutator bars in dynamos. It can be brazed and soldered nearly as well as brass.

CASTING ALUMINUM BRONZE.

Sound, clean castings of aluminum bronze can be safely and regularly made, either in sand molds or against chills, if the proper precautions are taken to avoid: first, oxidation; second, contamination from scum or a cinder composed of oxide of aluminum with a little copper in it; third, depressions, cracks or strains due to shrinkage; fourth, the shutting in of gas into the castings. The first trouble, oxidation, is due to heating the metal too hot in the plumbago crucible. The copper should not be heated much above its melting point before the aluminum is added, which at first absorbs a great deal of heat and rapidly thickens the metal, the aluminum being rapidly immersed in the copper to prevent its oxidation. Great care should then be taken in again bringing the metal up to the liquid condition, and the metal should be frequently stirred; for it suddenly heats up by the reaction of the alloying of the two metals, and, unless precautions are taken, will soon bring the temperature up to a white heat, where oxidation will seriously injure the bronze. The metal should have a cover of powdered charcoal to prevent oxidation, but with no other flux over its surface.

The second trouble, contamination from the scum, can be avoided by pouring from the melting furnace or pot into a hot ladle or pouring basin large enough to hold all the metal necessary to fill the mold and to allow the metal to pour out from the bottom of such a receptacle after giving sufficient time to allow the scum to come to the surface. A skim-gate should also be provided for each mold.

The third difficulty is caused by a peculiar red-shortness just after solidification and also a contraction at solidification which causes the metal to either tear apart or yield and cause depressions in the casting at more favorable spots, if any great resistance is experienced by the metal in contraction. This difficulty is overcome by giving bountiful allowance for the contraction, which can be done in several ways, each best adapted for varying conditions. The cores should be made of a yielding character, using resin or other suitable substance with coarse sand, that will yield to slight pressure. Unyielding iron core rods should be dispensed with as far as possible. "Green" sand cores will give good results in some cases. Other expedients to gain the same ends will be easily suggested by skilled molders.

The troubles due to shrinkage are avoided by having the "risers" or "feeding heads," with flaring openings, large in section, often larger than the castings they are intended to feed, and if necessary refilling the feeding heads, in some cases several times over. In this way the casting will solidify first, drawing metal to supply its shrinkage from the still fluid riser having a level higher than the casting itself, so that the metal will flow down into it. The gates to the mold should be sufficient in number and so arranged that they can be filled with the metal as cold as it will pour and give full castings. The considerable amount of scrap occasioned by the large sectioned risers can be remelted without loss of aluminum, and, indeed, is improved in quality by the process of remelting.

To prevent the shutting in of gas into the castings, dry sand should be used and the molds should be well vented by the ordinary precautions taken by founders for this purpose. Although it requires skill and experience to successfully carry out the conditions outlined above, sound, clean castings, even of the most difficult sections of aluminum bronze, can be made regularly, and with no more wasters than with ordinary brass, and without the

difficulty of a copious liberation of gas at the moment of solidification, as is the case with steel. In fact, aluminum bronze, with its low pouring temperature, is especially applicable for massive and heavy castings.

ALLOYS WITH SMALL PERCENTAGES OF COPPER.

The alloys of aluminum with copper in proportion of from 2% to 15% have already been incidentally referred to. Copper, I believe, is one of the best hardeners of aluminum. The maximum proportion that can be added before the metal becomes too brittle to work depends largely upon the purity of the aluminum. If it contains several per cent. of silicon it becomes very brittle with 5% of copper; but with pure aluminum, it is still forgeable, with difficulty, with 15% of copper. Even very small percentages of copper added to pure aluminum decrease the blue color of the metal and give a more pleasing yellow-white color to it.

Proportions of a few per cent. of copper added to pure aluminum decrease the shrinkage of the metal and give alloys that are especially adapted for art castings. The remainder of the series, from 15% copper up to over 85% copper, give crystalline and brittle alloys of no use in the arts, and of a grayish-white color, up to 80% copper, where the distinctly yellow color of the copper begins to show itself.

ALUMINUM WITH IRON AND STEEL.

Aluminum combines with iron in all proportions. None of the alloys, however, have proved of value, except those of small percentages of aluminum with steel, cast-iron and wrought-iron. So far as experiments have yet gone, other elements can be better employed to harden aluminum than iron, and its presence is regarded as entirely a deleterious impurity, to be avoided if possible.

The addition of from ½ lb. to 2 lbs. of aluminum to a ton of steel gives the advantage of quieting the metal in the mold and producing ingots with much sounder tops, so that the scrap due to crop ends is materially lessened, a saving which much more than pays for the cost of the aluminum added. The amount to be added varies with the character and condition of the steel. With well-melted steel, low in carbon, the proportion of from ⅛ to ¼ lb. to the ton seems to give the best results; any larger proportion making the metal pipe and causing excess of crop-end scrap. If the steel be "wild" in the ladle, full of occluded gases, too hot, or oxidized, a larger proportion of aluminum can be advantageously added. Mr. R. A. HADFIELD says, I think correctly, that the influence of aluminum appears to be like that of silicon, though acting more powerfully. The same writer, together with Prof. H. M. HOWE and Mr. OSMUND, claims that an addition of aluminum does not lower the melting point of steel. In this my own experience agrees; nor do I believe that aluminum increases to any great extent the fluidity of the steel. So far as my experience goes, steel, with an addition of $\frac{1}{10}$% of aluminum, seems to solidify in the molds fully as quickly as steel without the addition of the aluminum. Aluminum seems to take the oxygen out of steel very much in the same way that manganese does, but I am not aware of any advantages gained by using the more expensive aluminum for this purpose.

The addition of aluminum in quantities of from two to three pounds per ton are of advantage where the steel is to be cast in heavy ingots which will receive only scant work. Here it seems to increase the ductility as measured by the elongation and reduction of area of tensile test specimens, without materially altering the ultimate strength.

The question as to whether additions of aluminum prevent segregation of impurities in large castings of steel, is still an unsettled one; but I may say that it is now being carefully investigated.

In steel castings the benefit from the use of a small percentage of aluminum, ordinarily in the proportion of from 2 to 3 lbs. per ton, has become widely recognized, and it is being generally used.

The additions of aluminum are almost always made by throwing the metal in pieces weighing a few ounces each into the ladle as the steel is pouring into it. In cast iron, from 2 to 5 lbs. of aluminum per ton is put into the metal as it is being poured from the cupola or melting furnace. To soft gray No. 1 foundry iron it is doubtful if the metal does much good, except, perhaps, in the way of keeping the metal melted for a longer time; but where difficult castings are to be made where much loss is occasioned by defective castings, or where the iron will not flow well, or give sound and strong castings, the aluminum certainly in many cases allows of better work being done, and stronger and sounder castings being made, having a closer grain, and hence much easier tooled. The tendency of aluminum is to change combined carbon to graphitic, and it certainly lessens the tendency of the metal to chill. Aluminum in proportions of 2% and over materially decreases the shrinkage of cast iron.

The effect of aluminum in wrought iron is not very marked in the ordinary puddling process. It seems to add somewhat to the strength of the iron, but the amount is not of sufficient value to induce the general use of aluminum for this purpose.

The peculiar property of aluminum in reducing the long range of temperature between that at which wrought iron first softens and that at which it first breaks down and becomes fluid is taken advantage of in the well-known Mitis process. It is for this that aluminum is most used in wrought iron at present.

ALUMINUM AND OTHER METALS.

With the exception of lead, antimony, and mercury, aluminum unites readily with all metals; and many useful alloys of aluminum with other metals have been discovered within the last few years. I venture to prophesy the finding of many more in the near future, as more systematic attempts are made to study the use of aluminum with other metals and metalloids. The useful alloys of aluminum so far discovered are all in two groups, the one of aluminum with not over 15% of other metals, the other of metals containing not over 15% of aluminum; in the one case, the other metals imparting hardness and other useful qualities to the aluminum, and in the other the aluminum giving useful qualities to the other metals.

The alloy of a few per cent. of silver to aluminum to harden, whiten and strengthen the metal, gives a metal especially adaptable for many fine instruments, tools and electrical apparatus, where the work upon the tool and its convenience are of more consequence than the increased price due to the addition of the silver. The silver lowers the melting point of aluminum and gives a metal susceptible of taking a fine polish and making fine castings.

More or less useful alloys have been made of aluminum with zinc, bismuth, nickel, cadmium, magnesium, titanium, chromium, manganese and tin; these alloys all being harder than pure aluminum; but it is by combinations of these metals, with additions perhaps of copper, lead and antimony, that alloys of most useful value have so far been discovered. Some are with additions of only 1% to 2% of aluminum.

The addition of from 5% to 15% aluminum to type metal composed of 20% antimony and 80% lead makes a metal giving sharper castings and a much more durable type.

To ordinary brass, the addition of aluminum gives superior strength and better anti-corrosive qualities. Some very marked and valuable qualities have been discovered in the use of aluminum with zinc for various purposes.

The modifications of pewter, Britannia, white metal, Delta metal and the like, with additions of aluminum, have shown very useful qualities and will add very considerably to the demand for aluminum in the near future.

[To be continued.]

PERSONALS.

Mr. H. G. BOND, of Birmingham, Ala., has resigned his position as General Manager of the Tennessee Coal, Iron & Railroad Co.

Mr. EDWARD FORT has been appointed Superintendent of the Stillwater & Mechanicsville St. Ry., at Mechanicsville, N. Y.

Mr. W. C. PARMLEY has been appointed City Engineer and Inspector of Buildings at Ogden, Utah, to succeed Mr. T. A. PERKINS.

Mr. WM. E. CHAMBERLAIN has been appointed Commissioner of Public Works, at Providence, R. I., to succeed Mr. JOHN A. COLEMAN.

Mr. J. C. COX has been appointed Supervisor of Signals on the Louisville division of the Pittsburg, Cincinnati, Chicago & St. Louis R. R.

Mr. A. C. HUIDEKOPER, of Meadville, Pa., has been appointed Receiver, and Mr. T. J. BLAIR General Manager of the Meadville & Linesville Ry.

Mr. JOHN P. FORCE has been appointed City Engineer of Fostoria, O., vice Mr. G. D. HERSEY, who has resigned to accept a similar position at Youngstown, O.

Messrs. STONE, CARPENTER & WILSON, of Providence, R. I., have been appointed supervising architects of the new union station to be built at that city.

Mr. E. S. CALVIN, Division Superintendent of the Missouri Pacific R. R., has resigned and has accepted a position as Division Superintendent of the Union Pacific Ry., with headquarters at Pocatello, Idaho.

Mr. W. F. HOPKINSON has resigned his position as Assistant Engineer on the Elmira & Canandaigua division of the Northern Central Ry., to take a similar position on the Philadelphia & Erie division of the Pennsylvania R. R., with headquarters at Renovo, Pa.

Mr. C. V. MEHLER, the new City Engineer of Louisville, Ky., has appointed the following assistants: Mr. J. B. F. BREED, Assistant City Engineer; Mr. S. B. RANKIN and Mr. WM. M. BENEDICT, Assistant Engineers of Streets; Mr. C. J. O'CONNOR, Assistant Engineer of Sewers; Mr. L. B. REDD and Mr. JOHN RYAN, Superintendents of Street Repairs; Mr. H. L. KREMER and Mr. Wm. F. OFFUT, Superintendents of Street Construction.

Mr. JOHN WILEY, the founder and head of the publishing-house of John Wiley & Sons, and the oldest publisher in New York, died at his residence, in East Orange, on Feb. 21, aged 83 years. Mr. WILEY was born in Flatbush, L. I., and succeeded his father in the publishing-house of Wiley & Putnam, the latter member of the firm being Mr. L. P. PUTNAM. When Mr. PUTNAM, later, went into business for himself, Mr. WILEY'S sons took his place, and the third generation has been actively in the field for some years past. Mr. JOHN WILEY was the founder of the Church of the Puritans, an active member of the Home Missionary Society, and for many years President of the latter, and the founder of the Orange Valley Congregational Church.

Mr. ALEXANDER WINCHELL, Professor of Geology and Paleontology at the University of Michigan, died at Ann Arbor, Mich., Feb. 19. In 1859 the Michigan Legislature ordered a geographical survey of the state, and Professor WINCHELL was chosen as director of the work. From 1859 to 1862 he was state geologist and naturalist, and did valuable service of great importance to the state, showing the various formations, the mineral lands and locations of the salt-producing sections. In 1860 he submitted the "First Biennial Report of the Progress of the Geological Survey," and in 1865 he published a "Geological Map of Michigan." In 1866 he made the survey of the Grand Traverse region of Michigan, and in 1869 was appointed director of the geological survey of Michigan. He made an official survey of the salt lands of Minnesota in 1870.

Mr. J. R. ROBINSON, a consulting steam engineer, Boston, Mass., died suddenly Feb. 24, aged 68 years. In 1874 he was commissioned by the U. S. Government, in conjunction with President BARNARD, of Columbia College; Prof. R. H. THURSTON, Professor WINLOCK, of Harvard, and B. A. COPELAND to examine into the causes of steam-boiler explosions. Their inquiries extended over a period of two years; a long series of experiments being made at Sandy Hook and Pittsburg. He was also the author of a book on the causes of steam-boiler explosions. He had endeavored without success to introduce into practical use his "safety seam" for boilers. He had established at Quincy Point an elaborate plant for the construction of boilers under this system, but the ownership of the works became involved in litigation, and they never went into operation.

NEW PUBLICATIONS.

—*Commerce and Navigation of the United States.* 1890. Report of the Chief of the Bureau of Statistics. Pub. Doc. 8vo, pp. 1,026.

A few interesting facts can always be extracted from this volume. In the main it is a mass of detail tables of interest only as a matter of record for the benefit of law makers and specialists. Our shipbuilding interests are looking up a little; we built last year 234,122 tons of shipping, which is more than we have built since 1875, and rather more than we averaged for the decade 1865-70. In the last 5 years there has been a sharp and steady increase, from only 95,453 tons in 1885. Up to 1851 we had never built so much tonnage as in 1830, but from 1851 to 1861 we averaged only 367,000 tons per year.

The increase, moreover, is pretty well distributed. The following little table, abstracted from a fuller one on p. 1,021, shows the general course of shipbuilding since 1857.

U. S. TONNAGE BUILT IN VARIOUS YEARS.

In thousands of tons.

	N. E. coast.	Entire sea-board.	Miss. R. and tribs.	Great lakes.	Total.
1857.....	183.6	285.5	41.9	51.5	378.8
1867.....	135.2	230.8	35.1	39.7	305.6
1877.....	91.0	133.0	34.7	8.9	176.6
1887.....	24.0	83.1	10.9	56.5	150.5
1890.....	78.6	169.1	16.5	108.5	294.1

Our total tonnage is now 4,124,497 tons, against 5,539,813 at its maximum in 1861. Broadly speaking, our total tonnage has remained practically constant at its present figures since the close of the war. About 1,860,000 tons is now steam, however, which is nearly twice as much as it was then.

Last year, however, the percentage in value of total exports and imports carried in American bottoms was the smallest ever known, viz., 12.29%, against 17.18% in 1880, 35.6% in 1870 and 70.5% in 1857.

The Nickel and Copper Deposits of Sudbury District, Canada. By ROBERT BELL, B. A. S. C., M. D., L. L. D. Assistant Director of the Geological Survey of Canada. With an Appendix on the Silicified Glass-breccia of Vermilion River, Sudbury District. By George H. Williams. Pamphlet. 8 vo., 8 pp. Published by the Geological Society of America. February, 1891.

Sudbury is a town on the Canadian Pacific Ry., in Ontario, 36 miles north of the mouth of the French River, on Lake Huron. The surrounding country is hilly, broken up by rocks, ridges and swamps, with occasional tracts of land fit for cultivation. The timber in generally destroyed by forest fires. Copper and nickel, with other metals, were discovered here in 1882 while building the railway, and the district has since become an important mining center. Geologically speaking, the district is situated in the best known and perhaps longest Huronian belt in Canada. In the middle limits of this belt, where Sudbury lies, runs a long tongue of gneiss and red quartz-syenite, much interlaced. A singular feature of this formation is that it is in many places broken into large and small masses, with the interspaces filled by a breccia with a dioritic paste.

Two long and remarkable intrusions of diorite of a gray color are found cutting the gneiss and quartz-syenite

areas of this region. They are each about a mile wide in the middle, and run northeast and southwest, or parallel to the general strike of the stratified Huronian rocks nearest to them. Most of the heavier deposits of nickeliferous ore so far discovered are associated with these two diorite belts. These ores are found also in the gneiss, and quartz-syenite areas, and have a geographical rather than a single geological horizon. Dr. BELL thinks that, within certain limits, the ores might have their origin beneath all the rocks found at the surface.

The ore in all cases consists of a mixture of chalcopyrite and nickeliferous pyrrhotite, and the area covered, taking Wallace mine as a center, extends northeast 70 miles and northwest 50 miles. The concentration of ore at this place is believed to be due to the intersection of the ore-bearing belts either with one of the diabase dikes above described, or else by the pinching in or transverse disturbance of the belt. In the ore body the mass is made up of coarse and fine fragments of the country rock and the sulphides, while the ore itself constitutes the filling between them. The fragments of rock vary in size from mere grains to that of nuts and small and large boulders, sometimes packed so closely as to admit little or no ore between; at other times the spaces are wide and the ore solid in large quantities.

The genesis of the ore is traced to igneous fusions, and not to the accumulation of mineral matter igneous solutions. Dr. BELL reasons this out at length in this his treatise. Among other metals found in this district are gold, platinum, tin, lead, silver, zinc and iron, and it is probable that some of these may exist in paying quantities. The Huronian is notably a copper-bearing system, and as the search for this metal is yet in its infancy, there is no telling yet what may be found by further investigations.

In the appendix Mr. WILLIAMS describes a remarkable ancient glass breccia found in the Sudbury region that is to be particularly noted for its quantity and unusual preservation and occurrence in the world's crust. This breccia is made up of shaply angular fragments of volcanic glass and pumice, which, though completely silicified, still preserves every detail of its original form and microlitic flow-structure as distinct as if recently produced.

—*Compound Locomotives.* By ARTHUR T. WOODS, M., M. E., Prof. Mech. Eng. Univ. Ill. New York: National Car and Locomotive Builder. 12mo, pp. 167, 59 cuts, well indexed; $2.00.

This little work may be more correctly described as a critical summary of experience to date with compound engines than as a complete treatise on them; in fact, the time for the latter has not yet come. But we judge it to be by far the nearest approach to a treatise on compound locomotives which has as yet appeared, and to contain more information in regard to them than is to be found within the covers of any other one book. The work is a reprint of a series of articles contributed in the *National Car and Locomotive Builder*, and has the somewhat discursive and popular character that might be expected in such a series, but nevertheless a good deal of hard, honest work was evidently done in preparing them, and there is much original matter, the discussions of comparative starting power especially being really excellent and instructive.

We can cordially commend the work as worthy of study by all those interested in its subject. It takes up separately the various types of two-cylinder, three-cylinder and four-cylinder engines, and discusses them separately, giving for each their service records so far as they go which is naturally further with the two-cylinder type than with the others, since they have been longer in use. The tabular exhibit of tests with these engines is really an impressive one. It shows the results of no less than 19 different series of tests, made in six different countries of the old world, and all showing a large economy, ranging from 13 to 22 6%, and averaging 18.5%. For the other types of compound locomotives, the apparent indications are quite as promising, some of them even more so on their face, but, of course, no such record of many independent tests is as yet possible. Nor is it really proper to take these tests at their face value, as our author in part shows, but for the general fact that an economy of great importance can be realized by compounding at very small cost in additional complexity is now too clear for denial.

—*Boston Harbor.*—Report of Harbor and Land Commissioners for the year 1890. Pub. Doc. No. 11. Boston, 1891. 8vo. 73 pp. Maps.

Includes report on South Boston Flats, harbor lines, improvement of Charles and Mystic rivers, etc. Contains two large and excellent maps, showing the pier and bulkhead lines as established for the Charles and Mystic rivers by the War Department in 1890.

—*Baltimore Harbor.* Annual Report of the Harbor Board to the Mayor and City Council of Baltimore, for the year ending Dec. 31, 1890. Including report of N. H. HUTTON, Engineer. 8vo. 36 pp.

The report of Mr. HUTTON gives the detail of contracts, dredging prices paid, work performed, etc.

—*Papers of Engineering Society of the School of Practical Science*, Toronto, Canada. No. 3, 1889-90. 112 pp. and illustrations. Contains a number of good papers, and the first one, "A Short Historical Review of Sanitary Science and the Germ Theory," is especially worthy of note. In it the author, Mr. CESARE J. MARANI, briefly, but in an interesting manner, sketches the progress of sanitary science from its beginning, and adds to the value of his paper by giving his authorities in full, a feature too often omitted by writers. An article on Ontario cements is useful in describing the locality of quarry, quality and points of use of these cements.

TRADE PUBLICATIONS.

—*Central Station Electric Lighting Plants and Electric Railways of the United States.* Cloth, 107 pp., large 8vo. Thomson-Houston Electric Co., Boston, Mass.

The Thomson-Houston Co. has compiled an atlas showing the central lighting plants and electric railways in this country and the firms supplying the electrical machinery. According to this work, the Thomson-Houston Co. has fitted 666 lighting and 103 railway stations out of a total of 1,985 and 240, respectively. While these figures do not show the actual status of the company relative to its competitors, since all details of the plants and all statements of capital invested are omitted, nevertheless they clearly indicate the popularity and efficiency of Prof. THOMSON'S machinery.

—*Norwood Car Replacer.*—Pamphlet, 15 pp., containing description and testimonials. Norwood Car Replacer Co., Baltimore, Md.

SOCIETY PROCEEDINGS.

The Purdue University Society of Civil Engineers was formally organized this month, at the Purdue University, La Fayette, Ind. The following officers were elected: President, Enos L. Shaw; Vice-President, A. R. Herkass; Secretary and Treasurer, A. B. Dodd; Marshal, Edward Polk. At the first regular meeting of Feb. 17 papers were read on "Steel Railroad Ties," by C. B. Petersen; "Some Notes upon Railway Location," by Charles L. Ransend, and "The Freezing Process of Excavation," by Robert A. Lasky. The next regular meeting will be held on March 21.

Liverpool Engineering Society.—At the meeting on Feb. 4 Mr. A. J. Maginnis, M. I. N. A., exhibited and explained an electric automatic bridge indicator for steamships. Mr. Joseph Boult read a paper entitled "Notes on the Phenomena of Tidal Rivers, with special reference to the River Mersey." He dealt with the differences between tidal and non-tidal rivers, with the amount of tidal sea water entering the Thames and the Mersey, and the difference in tidal range between the west coast of Great Britain and the east coast of Ireland. The various phases of the tides in the tidal channels at the mouth of the Mersey were discussed, together with the numerous movements of the channels of the Upper Estuary. The Great Fret in the banks of the Upper Estuary was described, and conclusions were drawn from the examination of the monthly surveys showing the position of the navigable channel. Various suggestions were made for the improvement of the estuary of the river.

Engineers' Club of Minneapolis.—Annual meeting, Jan. 15, 1891. President William A. Pike in the chair and 16 members present. The second joint meeting with the Society of Civil Engineers of St. Paul is to take place in Minneapolis, March 5. The Secretary reported that since the reorganization of the club in May, 1890, the following papers had been read: Ventilation of School Buildings, by W. S. Pardee; Efflorescence on Brick, by Prof. W. A. Pike; Report on Trip to Cresson to the Annual Convention A. S. C. E., by Prof. Wm. A. Pike; Committee appointed to attend the meeting on International Congress of Engineers, called by the Western Society of Engineers at Chicago; general discussion of engineering topics; Estimating of Iron Highway Bridges, by F. W. Cappelen; Sewer Construction, by S. W. Sublette; Geodetical Survey of Minnesota, by Prof. W. R. Hoag; On Special Assessments of Public Improvements in the City of Minneapolis, by Chas. Q. Huntress.

The following officers were elected: President, Wm. A. Pike; Vice-President, T. P. A. Howe; Secretary and Treasurer, F. W. Cappelen; Librarian, A. B. Coe; Member Board of Managers' Association of Engineering Societies, Andrew Rinker.

Southern and Southwestern Railway Club.—About 20 members were present at the meeting held in Chattanooga on Feb. 19. The discussion on the proper mode of hanging brake-beams was continued from the previous meeting (see ENGINEERING NEWS, Feb. 21). All present expressed themselves in favor of hanging brakes on the inside of the wheels, and always from the truck frame instead of from the car body. The only point brought out in favor of outside brakes was the greater facility of repair; but statistics were given showing that the expense for maintaining inside brakes was fully 75% less than for outside brakes. The difference is largely due to the outside brake-beams coming in contact with locomotive pilots, buffing posts, etc. Other points of interest brought out were that the slack in air-brake connections could be taken up much better in brakes hung from the trucks, and that metal brake-beams were easier to get between the wheels than wooden beams.

The subject of preventing forgeries of defect cards was then taken up and it was advised that car inspectors be instructed to deface the remainder of the card after the defects have been enumerated upon it. It was also proposed by Mr. Gibbs that defect cards be printed in books with stubs attached, the latter to be filled out by the inspector. At the next meeting, to be held at Memphis, March 19, the subjects and speakers will be: "Breaking of Side Rods," M. P. Carson, Supt. Motive Power Mobile & Ohio, and "Exhaust Pipes and Nozzles," by L. C. Noble, Master Mechanic Houston & Texas Central.

Engineering Association of the South.—The regular meeting was held at Nashville, Tenn., Feb. 12. Vice-President W. L. Dudley in the chair, and about 30 members and visitors present. Mr. W. C. Smith, chairman of the committee appointed to prepare a memorial to the legislature asking the repeal of the Tennessee state law which levies a special privilege tax on architects and engineers, reported that he had responses to his circulars of inquiry from the Secretaries of State—38 states—all of whom stated that no tax was levied in those states on architects and engineers.

Mr. S. C. Lewis, chairman of the committee on highways, submitted a report recommending that a standing committee on public highways be appointed, consisting of one member from each state represented in the membership of the association, to secure short and pointed papers from members and others, to be read and discussed at the meetings of the association and to be printed in the press of the several states; and further, that the association from time to time pass such resolutions on the subject of public highways as may be applicable to any particular state or county to which the attention of the association may be called, and to communicate these resolutions to such persons as are in authority as expressive of the interest taken by this association in any movement made toward elevation of the public highway system of the country. The report was adopted, and the president will select a committee. The paper of the evening, entitled "Weather Forecasts and How to Make Them," was then presented by Sergt. J. B. Marbury, U. S. Signal officer, Nashville, Tenn. The paper presented in outline the development of the present system of forecasting weather employed by the U. S. Signal Bureau, and explained the manner of making the observations, transmitting the reports and preparing the predictions.

National Electric Light Association.—The annual meeting was opened in Providence, R. I., Feb. 17, with an address of welcome by Mayor C. S. Smith, followed by the annual address of the President, Mr. M. J. Perry. After the reports of several committees had been submitted, Mr. W. H. Markland read a paper on electric lighting in railway service, paying especial attention to its use in yards and stations, for which service he recommended high poles and ground globes. He regarded incandescent train lighting as much more expensive than the modern systems using carbureted gas.

The afternoon session was devoted chiefly to the reception of reports of committees, the only paper being on the distribution of steam from a central station, read by Mr. F. H. Prentiss.

The meeting on Wednesday morning was devoted to short addresses by Prof. Elihu Thomson, Messrs. T. D. Lockwood, F. H. Monks, J. E. Watkins, J. H. Herrick and others on the development of electrical industries. At the afternoon session Professor Thomson read a paper on the electric arc and its use in lighting, and Dr. Bell presented a committee report on the classification of incandescent lamps. The committee recommends as standard a lamp of 16 c. p., with a variation of not more than one candle in either direction when supplied with not less than 55 or more than 60 watts.

In the Thursday morning session Mr. C. B. Haskins presented a paper on the Ferranti system in London. Several drawings were exhibited showing the construction of the machines and transformers employed. The discussion which followed was chiefly upon the method employed in connecting converters on primary circuits. The next paper, on the "Distribution and Care of Alternating Currents," read by Mr. T. C. Smith, was one of the most important presented. It was ordered to be separately printed and distributed among the members for future discussion.

The report of the Committee on Data was presented by Mr. De Camp. It included statistics regarding accidents to electric light employés and with reference to the cost of generating the electric current. The latter statistics contain a large amount of information of value to central station managers regarding the actual coal consumption per horse power per hour.

The following officers for the ensuing year were elected at the afternoon session:

C. R. Huntley, President; J. I. Ayer, M. J. Francisco, Vice-Presidents; A. J. DeCamp, A. J. Corrireau, J. A. Seely, A. M. Robertson, C. R. Faben, H. H. Fairbanks, E. Peck, E. W. Rollins and J. J. Burleigh, Executive Committee; A. R. Foote, Secretary.

It was unanimously decided to hold the next meeting at Montreal. After a vote of thanks and the usual courtesies to the retiring officers, the convention adjourned.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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D. McN. Stauffer, A. M. Wellington.....Editors
Chas. W. Baker, E. E. R. Tratman, } Associate Editors
M. N. Baker, F. P. Burt, }
Geo. H. Frost.....Business Manager

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Civil Engineers' Society of St. Paul.—March, 2. Secy., G. L. Wilson.

Western Society of Engineers.—March 3. Secy., J. W. Weston, 230 La Salle St., Chicago.

American Society of Civil Engineers.—March 4. Secy. Francis Collingwood, 127 E. 23d St., New York.

Engineers' Club of St. Louis.—March 4. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

Technical Society of the Pacific Coast.—March 6. Secy., O. von Geldern, 408 California St., San Francisco.

Engineers' Club of Philadelphia.—March 7. Secy., Howard Murphy, 1122 Girard St.

Northwest Railroad Club.—March 7. Secy., H. P. Robinson, St. Paul, Minn.

Engineers' Club of Kansas City.—March 9. Rooms, Baird Building.

Civil Engineers' Club of Cleveland.—March 10. Secy., A. H. Porter, 50 Euclid Ave.

Denver Society of Civil Engineers.—March 10, "Mining Machinery." Secy., Geo. H. Angell.

Association of Provincial Land Surveyors of Ontario.—March 10. Secy., A. J. Van Nostrand, Toronto.

Civil Engineers' Association of Kansas.—March 11. Secy., J. C. Herring, Wichita, Kan.

New England Railroad Club.—Annual meeting, March 11, "Screw Stay Bolts;" election of officers. Secy., F. M. Curtis.

Engineers' and Architects' Club of Louisville.—March 11. Secy., G. W. Shaw.

Engineering Association of the South.—March 12. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Northwestern Track and Bridge Association.—March 13. Secy., D. W. Meeker, St. Paul, Minn.

Western Railway Club.—March 17, "Boiler Construction." Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery Bldg.

Engineers' Society of Western Pennsylvania.—March 17. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—March 18. Secy., S. E. Tinkham.

Engineers' Club of Cincinnati—March 19. Secy., J. F. Wilson.

New York Railroad Club.—March 19. Rooms, Gilsey House. Secy., H. G. Prout.

A GENERAL INDEX TO ENGINEERING NEWS, extending from the first issue of Volume I., in 1874, to the end of Volume XXIV. (July-December, 1890), is now in press, and will be issued about March 15, in a separate small volume, handsomely bound in cloth, which will be sold at $1. It will prove a valuable work of reference even for those whose files are not complete.

THE disaster of last week in the tunnel approach to the Grand Central Station, by which 7 lives were lost, with some 9 injuries, was the first one of serious moment since 1882, and the worst which has happened to a New Haven train since the famous Norwalk drawbridge disaster in 1853, by which 52 lives were lost. The cause of it is still obscure and still under investigation, there being a "conflict of veracity" between the trainmen, who swear the block signals were open when they passed, and the signalmen, who assert that they were shut and locked at danger, and that the train ran by both the usual home and distant signals and also an alarm bell intermediate between the two, which rang so long as the block ahead was occupied. As the Sykes block signal apparatus was in use in the tunnel, by which it is made impossible to open the block after a train has once entered it until the block is clear, and as the operators at the two cabins between which the collision occurred (Seventy-second and Eighty-sixth streets) agree in asserting that the signals were all right at the time, the probabilities seem to be that the train ran by the danger signals, being induced thereto by the fact that it was an unusual thing for this train to have another immediately in front of it, and by the further fact that the tunnel was obscured by unusually dense fog, steam and smoke. The moral of the occurrence as respects safety in the tunnel would seem to be that more powerful signal lights, displayed on both sides of the track, would give additional security at small additional cost. There is a loud demand that the whole tunnel be lighted, but in view of the fog and smoke which fills the tunnel most of the time it is questionable if this would really be conducive to safety. The use of electric arc lights instead of the present signal lights would probably be more effective.

BUT as respects the result of the collision there would seem to be no room for doubt that it was greatly aggravated by the Baker stoves on the cars, which were at once smashed by the collision, and at once set the train on fire, with the effect of considerably increasing the loss of life. It is therefore a direct result of the persistent opposition which the New Haven road has shown toward steam heating, and which has made it conspicuous throughout the country. One thin excuse after another has been advanced to explain this opposition, but the real motive has been sufficiently clear through it all, a reluctance to incur the expense of refitting the cars. Having now furnished a new illustration of the unwillingness of the New England roads to introduce reforms of practice until compelled to do so, it is to be hoped that the road will now bow gracefully to the inevitable, rather than wait for some new and worse disaster to compel them to do so, especially as it is pretty well established that they will save money by doing so, after the change has once been made.

It is particularly unbecoming in the New Haven road to resist improvements tending to promote the comfort and safety of passenger travel, because it has the heaviest passenger traffic of any road in the country. According to the last report of the Interstate Commerce Commission, the passenger miles per mile of road stand as follows on the leading passenger lines:

New York, New Haven & Hartford	567,628
Boston & Albany	500,802
New York Central & H. R.	399,974
Pennsylvania	288,968
Central of New Jersey	226,493

From these roads there is a sharp drop downward in volume of traffic. It ill becomes the road which is at the head of the list in traffic to be at the foot of it in readiness to adopt a plainly necessary betterment.

ACCORDING to the latest official returns, there were last year 5,000 persons injured and 250 killed by being run over in the streets of London. The latest corresponding report which we have at hand for New York is for 1888, and that shows that only 69 deaths were caused by street runovers, out of a total of not less than 1,258 accidental deaths of all kinds. It is an interesting coincidence that this is nearly the same number as are yearly killed by accidents to trains on *all* the railways of the United States. The full list of accidental deaths in New York City, by causes, is as follows:

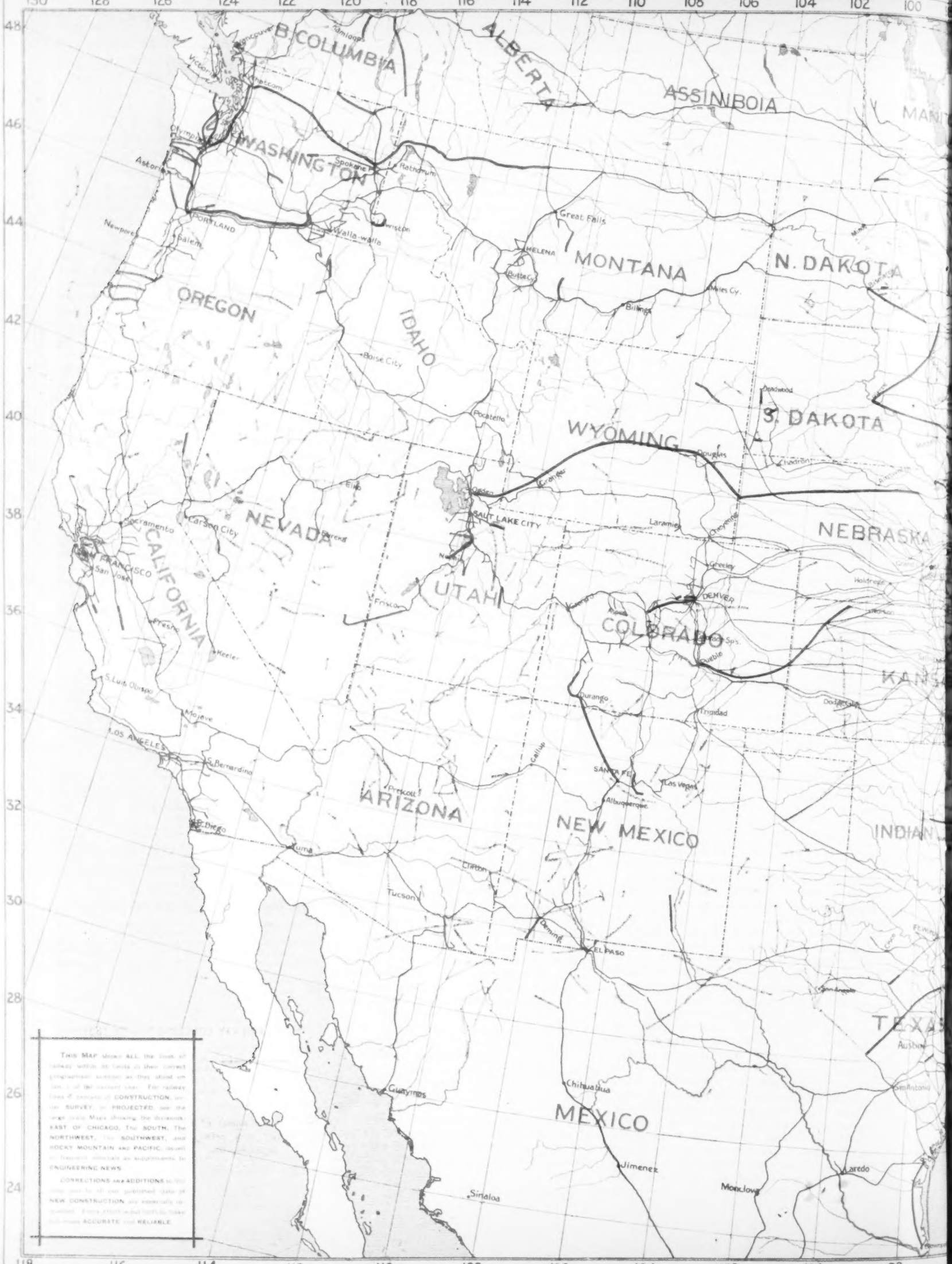
Fractures and contusions	151
Drowning	173
Neglect and exposure	9
Falls	391
Burns and scalds	122
Suffocation	85
Poison	173
Run over (exclusive of horse cars)	55
Run over on railways (including 14 by horse cars)	64
Electric light wires	5
Explosions	3
Malpractice	3
Wounds	21
Total	1,258

If the proportion between the various causes of accidental deaths is the same in London as in New York, there should be nearly 4,500 accidental deaths in that city yearly. It will be seen that the most prolific cause of death is falls, and that, in spite of the careful protection of railway tracks within the city limits of New York, no less than 50 persons yearly are killed on them.

HAVING given in our issue of Feb. 24 a demonstration in detail, accompanied by a diagram, showing that a schedule for handling trains on the Brooklyn Bridge announced as that proposed by the second Board of Experts, would produce a collision between every pair of trains unless by accident, we certainly expected that every cautious man or editor who had regard for his own reputation would first make pretty sure that he really understood the diagram, and that he had really discovered something wrong in it, before he ventured to attack it. One lesson to a wise man is commonly enough. We are pleased to find that, as respects the gentleman who reveals himself to the world as "Dot," this expectation proves correct, but our esteemed contemporary the *Railroad Gazette* rushes in, where even so careless an angel as "Dot" feared to tread, with the following brave words:

> The "impossibility" found in paragraph (*b*) of our article of Feb. 14] disappears when "Dot's" diagram and movements are read correctly. That is, the *B* trains are started first from the inner track. Thus the *B* train arrives on the tail track, clear of the switch (and of course still further clear of the crossing) 20 *seconds before* [italics ours] the *A* train starts to run down to the outgoing platform, and the "collision every 90 seconds" is purely imaginary.

Esteemed Contemporary, let us in all kindness advise you to drop the subject. You are floundering about in water too deep for you, like some of your professional abettors, and are in imminent danger of drowning yourself. Your arithmetic is at fault, and not merely your dynamics, which latter is a science much more advanced than arithmetic, yet also of importance in discussing questions like this. Substitute the word "*after*" in place of "*before*" in the above and you will have the thing straight at last; because $24 - 44 = -20$ or "after," and not $+20$ or "before," as you too hastily assumed. You will at once observe that it makes quite a material difference in the sense—or rather in the nonsense—of your sentence above. Let us write out the full schedule for you, in accordance both with "Dot's" letter and our diagram In it I means the incoming platform, S the stub switch, O the outgoing platform; "Arr." means "train arrives at"; "Dep." means "train departs from," and the bar ——— under certain figures means that it is between those two times that the train movements are made which obstruct the



THIS MAP shows ALL the lines of railway within its limits in their correct geographical location as they stood on Jan. 1 of the current year. For railway lines of remote or CONSTRUCTION, or the SURVEY, or PROJECTED, see the index maps. Maps showing the divisions, EAST OF CHICAGO, The SOUTH, The NORTHWEST, The SOUTHWEST, and ROCKY MOUNTAIN AND PACIFIC, issued as frequent intervals as supplements to ENGINEERING NEWS.

CORRECTIONS and ADDITIONS to this map, and to all our published data of NEW CONSTRUCTION, are especially requested. Every effort will be made to make this map ACCURATE and RELIABLE.

EMIL HART & SONS LITH. 26 VESEY ST. N. Y.

96 94 92 90 88 86 84 82 80 78 76 74 72 70 68 66

48 46 44 42 40 38 36 34 32 30 28 26 24

QUEBEC

MAINE

ONTARIO

MICHIGAN

WISCONSIN

MINNESOTA

IOWA

ILLINOIS

INDIANA

OHIO

KENTUCKY

W. VA.

VIRGINIA

MISSOURI

TENNESSEE

N. CAROLINA

S. CAROLINA

ARKANSAS

GEORGIA

ALABAMA

MISSISSIPPI

FLORIDA

LOUISIANA

NEW YORK

PENNA.

MD.

DEL.

MASS.

VT.

N.H.

BOSTON

NEW YORK

PHILADELPHIA

CHICAGO

Milwaukee

Toledo

Detroit

Hamilton

Buffalo

Rochester

Albany

Syracuse

St. Paul

Minneapolis

Duluth

Green Bay

Madison

Des Moines

St. Louis

Kansas City

Omaha

Memphis

Nashville

Louisville

Cincinnati

Columbus

Cleveland

Pittsburgh

Charleston

Richmond

Norfolk

Wilmington

Raleigh

Atlanta

Augusta

Savannah

Charleston

Jacksonville

Tallahassee

Tampa

Orlando

Mobile

Pensacola

New Orleans

Vicksburg

Natchez

Little Rock

Shreveport

Houston

Galveston

Dallas

Fort Worth

Denver

Omaha

Lincoln

Sioux City

Fargo

Bismarck

Helena

Butte

Spokane

Portland

Seattle

Tacoma

Boise

Salt Lake City

Cheyenne

Pueblo

Colorado Springs

Albuquerque

Santa Fe

El Paso

Phoenix

Tucson

Los Angeles

San Diego

San Francisco

Sacramento

Reno

Carson City

Las Vegas

Yuma

Oklahoma City

Wichita

Topeka

Kansas City

Abilene

Waco

Austin

San Antonio

Corpus Christi

Brownsville

Laredo

Amarillo

Lubbock

Roswell

Tucumcari

Gallup

Flagstaff

Needles

Barstow

Bakersfield

Fresno

Stockton

Modesto

Eureka

Crescent City

Medford

Klamath Falls

Pendleton

Walla Walla

Yakima

Wenatchee

Everett

Bellingham

Vancouver

Kamloops

Calgary

Edmonton

Regina

Winnipeg

Brandon

Prince Albert

Saskatoon

Moose Jaw

Medicine Hat

Lethbridge

Banff

Revelstoke

Nelson

Trail

Kelowna

Penticton

Vernon

Prince Rupert

Skagway

Dawson

Whitehorse

Fairbanks

Anchorage

Juneau

Ketchikan

Sitka

Nome

Barrow

Kodiak

Unalaska

Honolulu

Hilo

Kahului

Lihue

Nassau

Havana

Matanzas

Cienfuegos

Santiago

Kingston

Port-au-Prince

Cap-Haïtien

San Juan

Ponce

Mayagüez

Caracas

Maracaibo

Valencia

Barquisimeto

Ciudad Bolívar

Puerto Cabello

La Guaira

Port of Spain

Trinidad

Tobago

Barbados

Kingstown

Castries

Roseau

Basseterre

St. John's

Antigua

Montserrat

Guadeloupe

Martinique

Dominica

St. Lucia

St. Vincent

Grenadines

Grenada

Aruba

Curaçao

Bonaire

Maracaibo

Coro

Punto Fijo

Maracaibo

Cabimas

Lagunillas

Tía Juana

Machiques

Colón

Panama

Balboa

Cristóbal

Puerto Limón

San José

Alajuela

Heredia

Cartago

Puntarenas

Liberia

Nicoya

Bagaces

Cañas

Tilarán

Arenal

La Fortuna

Ciudad Quesada

Puerto Viejo

Sarapiquí

Guápiles

Siquirres

Limón

Bocas del Toro

Changuinola

Almirante

Chiriquí Grande

David

Puerto Armuelles

Concepción

Boquete

Volcán

Chiriquí

Alanje

Boquerón

Puerto Pilón

Gualaca

Remedios

Tolé

Santiago

Aguadulce

Chitré

Las Tablas

Los Santos

Pedasí

Macaracas

Las Minas

Herrera

Coclé del Norte

Penonomé

Aguadulce

Natá

Antón

La Pintada

Coclé

Olá

Aguadulce

Chitré

Las Tablas

Los Santos

Pedasí

Macaracas

Las Minas

Herrera

Coclé del Norte

Penonomé

Aguadulce

Natá

Antón

La Pintada

Coclé

Olá

0 100 200 300 400 500

150 MILES TO 1 INCH

ENGINEERING NEWS SERIES OF MAPS: No 31.

UNITED STATES.

RAILWAY CONSTRUCTION IN 1891.

——— LINES OF RAILWAY WHICH HAVE SOME PROSPECT OF BEING COMPLETED OR PLACED UNDER CONSTRUCTION OR CONTRACT BEFORE JAN. 1, 1892.

For details of progress on the various enterprises, with principal projectors or officers, see accompanying list.

94 92 90 88 86 84 82 80 78 76 74

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crossing, and which were shown by hatched areas in our diagram of Feb. 14:

Pairs of trains.	Train.	Arr. I.	Dep. I.	Arr. S.	Dep. S.	Arr. O.	Dep. O.
1st.....	A	.....	0′ 24″	0′ 24″	0′ 54″	1′ 24″	
	B	0′ 14″	0′ 44″	0′ 44″	1′ 14″	2′ 54″	
2d.....	A	0′ 54″	1′ 24″	1′ 54″	1′ 54″	2′ 24″	2′ 54″
	B	1′ 14″	1′ 44″	2′ 14″	2′ 14″	2′ 44″	3′ 14″
3d.....	A	2′ 24″	2′ 55′	3′ 24″	3′ 24″	3′ 54″	4′ 24″
	B	2′ 44″	3′ 14″	3′ 44″	3′ 44″	4′ 14″	4′ 44″

Here endeth the second lesson as to the schedule which was "so simple that any one could follow it." We may be pardoned for remarking that it is one thing to "follow it" with an understanding mind, and quite another thing to follow it merely with an open and receptive ear.

The Prospects of Railway Construction in 1891.

We present with this issue of ENGINEERING NEWS a map and statistics showing the prospects for railway construction in the United States during the present season. According to the summary of our detailed list there are now projected 18,814 miles of railway upon which work is now in progress or is likely to be commenced before Jan. 1, 1892. Of this mileage, 7,134 miles are partly completed or in process of construction, and 7,787 miles are located or under survey. The remaining 3,891 miles are not yet surveyed, but the preliminary work is being pushed with such energy that it is probable that contracts will be let before the close of the year. Comparing these figures with those published one year ago we have the following at the dates named:

	In process of construction.	Located or under survey.	Projected.
March 1, 1890	5,038	7,041	2,831
Feb. 28, 1891.....	7,134	7,787	3,891
Increase.....	2,096	746	1,060
" per cent.....	41.6	10.6	40.2

It would seem from the above that the prospects for new construction during the present year are much better than they were one year ago. In estimating the probable activity of work, however, several factors of the problem, outside of these figures, must be considered. The most uncertain of these is the recent financial stringency and the unsettled condition of the money market. This naturally affects the new enterprises more than it does those of the long established companies, and should these conditions continue during the year there will be a large falling off in this class of construction. On the other hand, should the present financial relapse prove transient, as it is generally believed it will, many of the enterprises upon which work is now suspended will undoubtedly be completed. This will be especially true of the South, where work is now suspended upon a large number of lines which are well advanced toward completion.

In regard to the extensions of the large systems matters are yet more uncertain. Several of these have extensions already in progress which will be completed, and should business remain good and the present comparatively peaceful state of affairs in the West continue it is probable that considerable additional construction will be done in the way of branch lines and local feeders.

It must also be borne in mind that a large number of the enterprises included in our list, which now seem to promise well, will fail entirely or be compelled to delay construction. And again, new enterprises, now in too chaotic a condition to be included on our map, may be taken up and pushed far toward completion. This is especially likely to be true in respect to the extensions of the large systems in the Far West.

It will be seen from our map and detailed list that the greater number of the lines in prospect are quite short, and are projected to develop local business In the majority of cases the territory entered is in need of railway facilities, and the prospects for a paying business are good. There are practically no paralleling schemes, and, with few exceptions, the various enterprises have a legitimate right to eventual success.

The following table gives a summary of the mileage in the various stages of construction and survey, by states and groups of states:

States.	In process of construction.	Surveyed or under survey.
NEW ENGLAND.		
Me.....	....	14
N. H.....	....	440
Vt.....	26	13
Mass.....	....	22
R. I.....	4	....
Conn.....	....	31
Total.....	30	520
MIDDLE ATLANTIC.		
N. Y.....	331	383
N. J.....	17	20
Pa.....	261	532
Md.....	94	30
Total.....	703	965
NORTH CENTRAL.		
Ohio.....	243	306
Ind.....	50	41
Mich.....	63	35
Ill.....	14	65
Wis.....	77	171
Total.....	447	618
SOUTH ATLANTIC.		
Va.....	190	175
W. Va.....	238	33
N. C.....	408	342
S. C.....	258	70
Ga.....	456	215
Fla.....	88	15
Total.....	1,638	850
CANADA.		
Ont. & En. Prov.	136	315
Man.....	307	....
B. C.....	61	150
Total.....	504	465

States.	In process of construction.	Surveyed or under survey.
SOUTH CENTRAL.		
Ky.....	76	270
Tenn.....	329	311
Ala.....	420	293
Miss.....	....	300
La.....	153	223
Total.....	978	1,397
SOUTHWESTERN.		
Ark.....	163	177
Mo.....	36	378
Tex.....	361	150
Kan.....	55	130
Ind. Ter.....	140	50
Colo.....	10	361
N. Mex.....	30	199
Total.....	795	1,445
NORTHWESTERN.		
Ia.....	40	5
Neb.....	280	87
Minn.....	96	50
N. Dak.....	16	....
S. Dak.....	198	251
Wyo.....	475	....
Mont.....	300	200
Total.....	1,405	593
PACIFIC.		
Cal.....	106	242
Ore.....	137	231
Wash.....	499	913
Utah.....	269	....
Nev.....	67	....
Idaho.....	78	13
Total.....	1,138	1,399

Total for the United States: In process of construction, 7,134 miles. Surveyed or under survey, 7,787 miles. Projects of much promise, 3,891 miles.

Total for Canada: In process of construction, 504 miles. Surveyed or under survey, 465 miles. Projects of much promise, 374 miles.

From this it is seen that the greatest activity is confined to the South and Southwest, the states of Pennsylvania, Ohio and New York in the Central Northern section of the country, and the states of Washington, Montana and Oregon in the far West. Washington heads the list in the totals of all prospective work (including all classes of work—construction, surveys and projects), having 1,478 miles to its credit. Closely following comes Alabama, Georgia and North Carolina, with 1,151 miles, 979 miles and 913 miles, respectively. Of the other states New York and Texas have over 800 miles each, and Pennsylvania, Montana and Tennessee over 600 miles each.

Considering the work by groups of states, we find that the South Atlantic group takes the lead with 3,253 miles, and the South Central and Southwestern groups follow with 3,156 miles and 2,870 miles, respectively. The three southern groups thus contain 9,279 miles, or 43.1 per cent. of the total prospective construction of the United States, a very remarkable evidence of the rapid development of this section of the country, when it is remembered that over 45.7 per cent. of the railway mileage constructed in our country during the last five years is comprised in the 18 states of these three groups. In the 5 northern groups the work is divided as follows: Pacific, 2,693 miles; Northwestern, 2,513 miles; Middle, 1,876 miles; North Central, 1,686 miles, and New England, 817 miles. These totals include all classes of work—construction, surveys and projects.

In the following table is shown the comparative mileage under construction and survey in each groups of states at the dates of March 1, 1890, and February 28, 1891, together with the increase or decrease per cent.:

TABLE SHOWING BY GROUPS OF STATES THE COMPARATIVE MILEAGE UNDER CONSTRUCTION AND SURVEY MARCH 1, 1890, AND FEB. 28, 1891.

Group of states.	In process of construction.			Surveyed or under survey.		
	1890.	1891.	Inc. or dec., per ct.	1890.	1891.	Inc. or dec., per ct.
New England.....	25	30	+ 20.0	486	520	— 7.0
Middle.....	604	703	+ 16.4	1,106	965	+ 21.8
No. Central.....	530	447	— 15.7	792	618	— 9.34
So. Atlantic.....	961	1,636	+ 70.2	1,778	850	— 52.1
So. Central.....	1,246	978	— 21.5	690	1,397	+ 10 2
Southwestern.....	966	795	+ 30.1	665	1,445	+ 11.7
Northwestern.....	599	1,405	+ 40.3	725	593	— 18.2
Pacific.....	407	1,138	+ 10.6	799	1,399	+ 75.1
Total U. S.....	5,038	7,134	+41.6	7,041	7,787	+10.6
Canada.....	914	504	— 44.6	438	465	+ 6.17

In the New England groups the only important lines are those projected into the lumber regions of northern Maine, and the prospects are not flattering for the early completion of these. Otherwise the work is confined to short local lines and branches. The same can be said of the work in the middle group, with few important exceptions. The most noteworthy of these exceptions are the extensions of the Lehigh Valley R. R. to Buffalo, N. Y.; the short cut being built by the Pennsylvania R.R. from Downington, Pa., to Morristown, N. J., 50 miles; the Mohawk & St. Lawrence extension of the New York Central, 170 miles, and the partly graded Baltimore & Drum Point R. R., 82 miles. The most important of these is the double-track line of the Lehigh Valley R. R., from Van Ettenville, N. Y., via Geneva, to Buffalo, N. Y., 146 miles.

Work in the North Central States is confined principally to Ohio, and consists in lines intended to give the Hocking Valley coal fields new outlets to Lake Erie. Among the projected lines the extension of the Wabash R. R. to Chicago is the most important.

Farther south the work is located in the mountain regions and in middle and northern Alabama and Georgia. The principal of these enterprises are the extensions of the Norfolk & Western, the Atlantic & Danville, the Richmond & Danville and Georgia Southern & Florida railways, and the several branches of the Atlantic Coast Line and Seaboard Air Line systems. The lines of the southwest consist largely of the extensions of the Missouri Pacific Ry. and of more or less important local enterprises, all of which are sufficiently described in our detailed list.

In the eastern northwest the more important enterprises are the extension of the Northern Pacific from Oakes to Pierre, in the Dakotas, and the much-advertised Pacific Short Line. The latter is projected to run from Sioux City, Ia., to Ogden, Utah, about 900 miles. Of this, 128 miles have been completed from Sioux City west, and the remainder is under contract. Just now, however, the work is confined principally to the endeavors of the newspaper reporters to discover which of the several great systems is backing the enterprise.

West of the one hundredth meridian nearly all of the work is projected in the states of Montana, Idaho and Washington. The most important line is the Great Northern extension to the Pacific coast. The work of construction and survey is being pushed all along the line, and it is probable that a large portion will be completed during the year. Nearly all of the remainder of the prospective work is confined to the region tributary to Puget Sound, and is projected in the interest of the Union Pacific, Northern Pacific, Great Northern and other large enterprises.

Taking the country as a whole, it is seen that a large mileage of new railways is well advanced toward construction. A large proportion of this will eventually be built. Just how much will be constructed this year, however, depends largely upon conditions already mentioned.

The Bottom Facts of the Brooklyn Bridge Question.

II.

We complete herewith, according to promise, our summary of the facts affecting the practicability of the plans lately recommended by the second Board of Experts, which is merely the so-called Barnes-Martin plan adopted by the trustees three years ago.

The existence of the four distinct elements of impossibility in the adopted plans, which we demonstrated to exist in our issue of Feb. 14, are admitted by implication in a letter signed "Dot," which appears in the *Railroad Gazette* of Feb. 21, and is reprinted below. These four impossible features were:

Under the Leverich schedule for train movement:

1. One engine must be in two different places doing two different things at one and the same time.
2. There was no time for the switch engine to squeeze through over the crossing, even if the first miracle could be accomplished.

Under the "Dot" schedule, announced as that proposed by the second Board of Experts:

3. A collision resulted between every pair of trains every 90 seconds if they were precisely on time; or, otherwise, between every other pair, which could only be avoided by cutting off the switch engine from a chance to get over the crossing.
4. The time for the switching movements was shortened up on paper to a time far below that which experience had shown to be necessary, viz., from 48.8 to 30 seconds.

To these *four* elements of impossibility Mr. "Dot" does not even attempt to answer or deny more than the last one, after having had a week (not to say three years and a week) to think the matter over carefully. The following is his note:

To the Editor of the Railroad Gazette.

In ENGINEERING NEWS of Feb. 14 Mr. WELLINGTON prints a rejoinder to my letter to you of Feb. 6, in which he states at length a difference between us which can be decided only by actual determination of the fact; that is to say, whether the trains can be handled in the time which I have allowed for them, or whether they will require the longer interval which he considers necessary. *Having witnessed and timed the easy and regular movements of the trains with the present arrangements, and having found them, when active movements were required, to occupy less than the time allowed in my calculations,** I have no doubt of their correctness. DOT.

It would have been much better to have said nothing than to have said this, for it will be seen that it amounts to a practical confession of the other three defects; and as to the other one, which it is attempted to deny in the italicized statement above—speaking with a full sense of the responsibility we assume, and with no desire to introduce avoidable asperities into a discussion of this kind—we declare the italicized statement to assert a demonstrable untruth. What is declared to have been done has never once been done. "Dot" and his sponsors might as well attempt to prove by declarations that they saw the moon shining on a moonless night. We do not deny (though we have our doubts) that by handling trains with sufficient recklessness they may be switched back once or twice in something like the time asserted, but this is a very different thing from what "Dot" asserts; and that it can be done a dozen or half-dozen times in succession "when active movements are required," *i. e.*, in the rush hours, at which time some respect must be paid to the safe handling of trains, or that trains can be handled even once under the full "Dot" schedule, even on the present single switching system, with no danger of crossing collisions to consider, is a demonstrable impossibility. We will not occupy the considerable space which a full demonstration of this fact would require, because it is always open to the Bridge officials to actually do what is declared to be impossible, if they can, and thus disprove all criticisms.

The case is much as if some one should assert that they could and would run trains between points 75 or 80 miles apart in an hour, with any known type of locomotive. It is undoubtedly possible to maintain that rate of speed for short distances and under favorable conditions; therefore we could not deny that some single train *might* have made the whole distance at that rate, though we might have doubts about it; but to assert that enough runs had been made to demonstrate that that speed could be and was maintained and maintainable *under ordinary working conditions* would be to make a very different assertion, almost as certainly impossible as the statement which we have declared to be so. The evidence on which we declare them to be impossible may be inferred in part from our discussion of the remaining details of the plan, which we now resume.

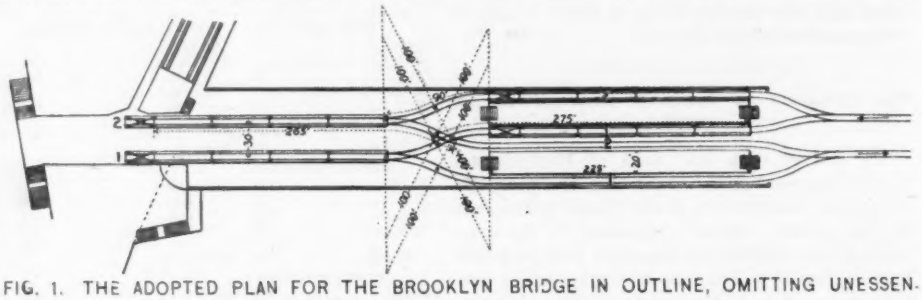


FIG. 1. THE ADOPTED PLAN FOR THE BROOKLYN BRIDGE IN OUTLINE, OMITTING UNESSENTIAL FEATURES. [Reproduced from our Issue of Feb. 14.]

1. In our preceding diagrams and discussion we assumed throughout (a few paragraphs excepted) that the trains could and would be operated on a schedule exact to the second. We need hardly say that even a close approach to such exactitude is not to be counted on; and, had allowance for unavoidable eccentricities been made in the diagrams which we published, it would have made their exhibit still more decisive.

2. It is asserted as "probable," in the second Board of Exports' report, that the headways of 45 seconds, which we have shown to be impossible, "can be reduced to 40 seconds"; and computations of capacity are given on that basis, as quoted in our issue of Jan. 24. If this were in fact possible under the proposed double-slip system of switching, as shown in Fig. 1, it would be still more easily possible under the present single-slip system of switching; but, on the contrary, experience has shown this to be impossible, even with the single-slip system. This becomes clear by reciting a few facts of past experience.

The bridge was operated from October, 1883, to Sept. 15, 1884, with 2-car trains, and from that time till Sept. 9, 1888, or 4 years, with 3-car trains, there being a constant pressure during the last half of this time to add more cars or shorten the headways, if possible. Since Sept. 9, 1888, 4-car trains have been run, with the same pressure almost from the first.

The headway between trains is limited by the time required for switching, and nothing else; so that for at least 5 years past, and practically from the beginning, there has been a steady pressure to cut down the time taken for switching to the lowest possible limit.

As an effect, trains were run on 90 seconds headway with 2-car trains almost from the first (March 5, 1885); and by using heavier switch engines it has proved possible to maintain these headways with 3-car trains and 4-car trains. What has actually been done in the way of reducing this headway below 90 seconds to meet the steady demand for more capacity? A pamphlet before referred to* gives all that has been done or attempted in this way up to 1890, as we have been officially assured. It is as follows:

(*a*). March 2, 1886, 80 seconds headway with 3 car trains was maintained experimentally for the whole *or a part* (not stated which) of one day as a preliminary to starting to run on 90 seconds headway, which began 3 days later (March 5), and was continued for 19 months *without an attempt to reduce the working headways below 90 seconds.*

(*b*). Sept. 27, 1886: "Experimentally 3 *3-car and* 10 *2-car trains* were run on 80 seconds headway 1¼ hour in the morning and 2 hours in the evening." The next day a return to 90 seconds headway was made, which continued in use without attempt to abbreviate it for 23 months (until Sept. 9, 1888) with 3-car trains, in spite of the severest pressure to get all the capacity possible. At the date last named 4-car trains were put on, and 90 seconds headways have been maintained for them, though the switching run is necessarily 50 ft. longer. No single attempt has been made since (or, at any rate, any successful attempt which is acknowledged) to run the present *single*-switch system in less than 90 seconds headway, though the increasing pressure of traffic has called continuously for all possible accommodations.

In spite of this conspicuous inability to shorten down the headway of a single-switch system to less than 90 seconds for even a single experimental hour, a Board of Experts is found ready to declare that a double-switch system, with all its added complications, can "probably" be operated on an 80-seconds headway for each track, or 40 seconds average headway. Moreover, in spite of the proved inability to reduce the time for switching back from the platform to the stub to less than 40 to 65 seconds, averaging at present 43 to 45 seconds, we are asked to believe, on the authority of "Dot," that

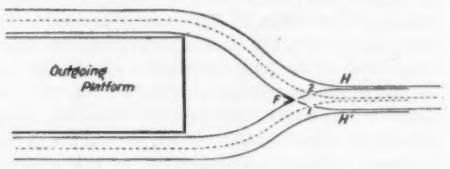


Fig. 2.

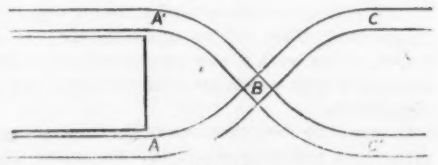


Fig. 3.

"Within the past week" trains have been switched backed in less than 30 seconds "when active movements were required," *i. e*, in the rush hours! If they can do it with a double system, even for an hour, why don't they do it now, with a single system, at least for an hour? A brief computation will show that if they could work the "Dot" schedule, even with single system, with all trouble from crossing collisions eliminated, it would make 60 seconds headway (or even less) easy, or increase the present capacity more than 50 per cent.* Existing

* The italicized statement the *Gazette* amplifies and makes more specific as respects one part of the "Dot" schedule, in the following words:

"Within the last week trains have been repeatedly switched from the incoming platform to the stub, not only in 30 seconds, but in periods of from 28 seconds to 35 seconds."

* Traffic Capacity of Br. Bridge, by G. LEVERICH, Asst. Engr., p. 15.

* The schedule would be as follows: I standing for the incoming platform, S for the stub or switch, and O for the outgoing platform:

Train.	Arr. O.	Dep. O.	Arr. S.	Dep. S.	Arr. O.	Dep. O.
1.	0'0"	0'30"	1'0"	1'0"	1'30"	2'0"
2.	1'0"	1'30"	2'0"	2'0"	2'30"	3'0"
3.	2'0"	2'30"	3'0"	3'0"	3'30"	4'0"

And so on indefinitely. In this there is no interference but, on the contrary, needless clearance, always assuming such quick movements to be possible.

circumstances alone are proof enough that it cannot be done, nor any sensible approach made to it, in a manner consistent with safety.

3. We come now to a feature not heretofore alluded to, that trains could not even be run into and out of the station in the manner proposed. Fig. 1 (reproduced from our issue of Feb. 14) shows the plan as a whole, and Fig. 2 shows by sketch to a larger scale the details of egress recommended by the Board, in which the two cables of the gantleted tracks follow around the reversed 100-ft. curves by which the tracks separate from each other, and extend thence along the outgoing platform, so that the outgoing train grips the cable while standing at the platform.

One other alternate mode is possible, viz., to "kick" the trains out over these reversed curves by a locomotive, and let them grip the cable only after they have passed on to the straight track beyond the curves, as is done now at the Brooklyn terminus. That the second Board of Experts did not contemplate using this mode of starting trains, however, is distinctly shown in the communication of "Dot," published Feb. 14, in which it is stated that the trains are to be "kicked" out from the rear stub to the outgoing platform, whence it follows that there can be no engine at hand to give the train a "kick" away from the outgoing platform.

Either one of these methods of starting out the trains involves such elements of impossibility as to make them entirely impracticable. We consider first the method which the second Board of Experts must have had in mind, in which the cables run back around the curves to the outgoing platform, from which platforms it is announced that trains were intended to be run in pairs at alternate intervals of 20 and 70 seconds.

First, as to the nature of gantleting: It is an unfamiliar and unprecedented device for operating any great length of track. If used on the bridge it will be the first time it ever has been so used anywhere in the world, it having been used here-

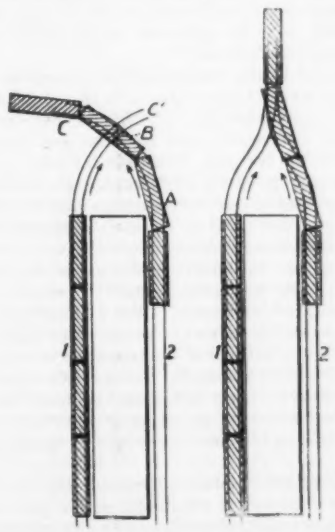


Fig. 4.

Fig. 5.

tofore only to carry a double-track road over a single-track bridge, where trains were run at intervals of many minutes apart. Therefore, the rules of practice in regard to gantlets are not well settled by experience, and it is quite possible for any one to propose things in connection with them which they would never dream of proposing in regard to older equivalent devices, as to which practice has become settled by long experience.

This is precisely what seems to have occurred in regard to this gantleting proposal. Its real nature has not been apprehended; but it is readily shown that for all operating purposes *a gantlet is a crossing*, nothing more nor less. It has every element of danger of a crossing, with still more liability of derailment. This will be evident by comparing Figs. 2 and 3, the first showing the gantlet plan recommended by the Board, and the second its operating equivalent.

For, what is the element of danger in a crossing? Plainly the parts *A* and *B*, Fig. 3, where the train approaches or is on the crossing. After *A* and *B* are passed, it makes no difference in what direction the tail-track, *C*, runs—whether it runs off in an entirely different direction, as in Fig. 4, or turns back parallel with the other track, as in Fig. 3, or interlocks with it on a gantlet, as in Figs. 2 and 5; except, indeed, that the latter prolongs the part *B*, Fig. 3, indefinitely, and so increases the danger of collision.

So far as operating safety is concerned, therefore, the tracks may as well cross each other completely, as in Figs. 2 and 4, as to be gantleted, as in Figs. 2 and 5. The two are operating equivalents. There is therefore, in effect, a *grade crossing* directly in front of every incoming and outgoing platform, over which opposing trains crowded with 400 to 500 passengers each pass in pairs at intervals of only 20 seconds from head to head of train, *or only 6½ seconds apart in the clear*, the train being 16⅔ seconds long when running at the full speed of 14⅔ ft. per second, or 10 miles per hour.

Is anything more than this simple statement necessary to demonstrate the fatal and utter absurdity of the plan of operating, which has been lately adopted, apart from the other absurdities in it which we showed last week? If there is, we will proceed to add it.

The trains do not pass the crossing (*i. e.*, enter the gantlet) at full speed, but almost in the act of starting from the platform. This act of starting has been performed, since the bridge was opened to traffic, by nearly 1,000,000 trains, out of which we have the actual record of the time taken for starting (from the moment of applying grips to the time when the train was moving at cable speed) for 17 trains only. The variations in the time taken by the remaining 999,983 trains can only be guessed, but the record for the 17 known trains varies as follows:*

	Time, seconds.	Distance covered, ft.	Remaining distance to clear crossing.	Total time to clear crossing, seconds.	Rail.
Quickest start	10.0	88	187 ft. 13.75	23.75	Dry
Slowest "	18.3	134	141 " 9.6	27.9	Wet
Next slowest"	18.0	132	143 "	27.7	"
Av. of 11 trials	14.5	106	169 " 11.5	26.0	Mixed wet & dry
Av. of 6 "	11.4	84	191 " 12.9	24.3	All dry tests

In only 17 out of 1,000,000 trials, therefore, the time of getting under way varied as 10 to 18.3 seconds, and the time necessary to clear the crossing varies from 23¾ to 28 seconds. The second train must always start, therefore, while the first train still has from 1 to 3 cars yet to pass over the crossing, which is only 60 ft. in front of it. The trains would therefore stand *twice out of 17 times at least* (see table above) in the position shown in Figs. 4 and 5; from which it will be seen at once that the gantleted tracks are more dangerous than the crossing proper, especially with both trains attached to the cable. To run on 20 seconds' headway it would be regularly necessary to start train 1 before train 2 had run its own length, since it rarely does this in the first 20 seconds after starting.

By computations of a simple nature, which we will not take the trouble to explain, train 2 will take 9½ seconds to clear the crossing in the position given, and train 1 about 9.1 seconds to reach it—bringing about a collision.

It will be seen that a collision between every pair of trains would be escaped by only 2 or 3 seconds, even if everything were on time to the second; while we need not again point out that between precision to the second and practical operating conditions there is a vast gap which the prudent do not seek to cross. Both trains, it is to be remembered, are likely to be packed to repletion with nearly a round thousand of passengers. Supposing we enlarge "Dot's" 20 seconds headway to 30 seconds; are the conditions sensibly safer?

4. There is another risk besides that of collision in track like that shown in Fig. 2, viz., derailment, which is especially serious if they are attached to the cables. Let us see how that stands:

The 100-ft. radius curves reverse very near the frog point, *F*, Fig. 2. In addition, there must be gaps in the rails of at least 3 ins. at the points 1 and 2, to permit the cables to lie beneath the rail level, except when lifted by a train attached to them. The entire lead from *F* to *H* or *H'* *cannot be guard-timbered*. The centrifugal force in passing over such a curve at 10 miles per hour is great, and tends strongly to cause derailments. Derailment at such a point is therefore a constant possibility, and it would mean prompt and serious disaster if the train were attached to the cable. The derailed train would be apt to run off so erratically as to foul the cable and grips; and panic at least would ensue from the instant of derailment.

These difficulties are so very serious that we have not the least belief that running the cables back to the platform has ever been seriously contemplated. The Board of Experts seemingly thought it was, for their published plan and schedule of train movement calls for it; but if even the first preliminary study has yet been made for this detail of the plan, which has stood as "adopted" for three years, we are false prophets. Should the plan ever be carried out (which we do not believe it will be), it will suddenly be found that it will "simplify" it to stop the cables in front of the crotch of the gauntlet and "kick" the trains out to it by a switch engine, as they are now kicked out at Brooklyn, and as they are kicked at New York from the rear stub to the platform. But the meaning of this "simplification" will be the addition of a maze of switching tracks not now shown upon the plan as laid before the Board of Experts, and indorsed by them, and a further reduction of the real percentage of increase below the 45 per cent. which we have allowed.

* Abstracted from the table on page 28 of Mr. LEVERICH'S pamphlet "Traffic Cap. Br. Bridge."

CORRESPONDENCE.

The Pegram Truss.

BALTIMORE, Feb. 23, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of Feb. 14 you illustrated a novel type of bridge now being built for the Missouri Pacific Ry. and designed by Mr. GEO. H. PEGRAM, Consulting Engineer, and in the following issue you published an extract from a personal letter of the designer.

Mr. PEGRAM'S design is of such decided originality and developed with such a keen insight into the true economy of bridge construction, that such illustrations should not appear before bridge engineers only to be laid aside without a fair examination into the merits and an impartial criticism.

As to the appearance, no one can deny that it has more beauty and gracefulness than can be given to the straight or "broken back" Pratt, or in fact any other type in general use.

That which particularly attracts attention is the greater length given to bottom than to top chord panels, exactly what is needed, not only for economy, but for solidity, and this feature presents at once a favorable solution of how to obtain a heavy floor without sacrificing material in the top chords.

Mr. PEGRAM'S method of bracing the bottom could not be better; it is rigid, simple and permanent there being no adjustment of rods which, when drawn tight in summer, are likely to be overstrained in winter, and when adjusted in winter will be loose and vibrate in summer.

This same stiff bracing being riveted to stringers, holds them laterally and does away with the bracing usually required to limit the unsupported length of flanges to 12 times their width. It is very strange that engineers, who unhesitatingly acknowledge that a stiff angle bracing is far

superior to the usual method of adjustable rods, are so slow in adopting that which their judgement dictates is best. A very casual inspection of the strain sheets will show at once that Mr. PEGRAM's bottom lateral system is not only superior in rigidity, but that there is actually less weight required and the shop work is simple and less expensive than for rods with clevises or turnbuckles, thereby offering economy both in weight and cost of workmanship.

It is hard to understand, however, why, after adopting a stiff bottom bracing, he should adhere to the adjustable rods in the top system and connect them to the top of the top chords in a manner which, although it possibly answers the purpose well enough, is a trifle antiquated and hardly in keeping with the newness of the other features in his designs. A stiff top bracing would have more weight, but only a trifle more, while it would give his structure all the combined advantages of the stiff riveted girders and pin connected trusses without the inherent objections.

In all bridges where the floor beams are connected below the bottom chords it is difficult to obtain a satisfactory bottom lateral connection without introducing objectionable features. It is readily admitted that the laterals should be connected directly to the chord joint pins, or at least as near the pin as possible. Various attempts have been made to overcome the difficulty. Some engineers introduce a strip of wood between stringers and ties, and by connecting the rods to the top flanges of floor beams they pass through openings in the timber above stringers. Others again elevate the center of the floor beam and allow top flanges to taper toward the end. In this case the stringers are riveted to webs of floor beams as near the top as possible, and the rods being connected to top flanges of floor beams, pass through openings made in webs of stringers directly under their top flange angles.

Both the above methods have their objections, the first on account of the difficulty of replacing the raising strips when they begin to rot, and the second on account of bends in the top angles of floor beams which, to say the least, will weaken the metal and may even cause cracks to appear along the fillets.

Mr. PEGRAM has again met all objections in the design of his floor beams and connections of the bottom laterals in such a manner as to transmit their stress directly to chords and floor beams without inducing secondary strains; but he has introduced the objectionable timber strips on top of the stringers, although this could have been easily avoided with his style of floor beams.

Engineers as a rule do not love adjustable hanger connections at end of floor beams, and especially so when a pair are used at each end, the objection being that they will shake loose in spite of double nuts, and that the deflection of the floor beam will produce a greater strain in the inner than in the outer hangers, and consequently an uncentral loading on pins. Whether these hangers will shake loose or not, the writer is unable to say from personal experience, and candidly confesses that so far as he is concerned, this objection may be one of imagination only, no doubt due to the fact that a stiff-riveted connection between floor beams and posts has been ding-donged throughout the country for the last ten years or so. It is, however, almost impossible to make a satisfactory riveted connection even when posts are vertical, and would, of course, be out of the question in the present case. The writer would prefer in such cases to use a flat bar with a hydraulic forged head, the same being riveted to the end stiffeners of floor beams, and the floor beam stayed against motion by means of a bent plate or angle, with one leg riveted to top flange of floor beam and the other to inner side of post. However, if adjustable hangers are placed close together as shown on drawings, and the fear of loose nuts is illusory, no substantial objections to their use can be offered.

It will be observed that the objections offered concern some details only, the general conception of Mr. PEGRAM being excellent, and eliciting nothing but the most unqualified approval from all capable of knowing a good design when they see it. Mr. PEGRAM has, of course, secured letters patent on his bridge, and the design cannot be adopted generally without his consent. This is to be regretted to a certain extent, but we cannot expect a man to devote his talents and brains for the free public use without compensation in some form or another. In these days of competition a man cannot afford to exchange labor for glory. There is no doubt that the time will come when the Pegram truss will supersede the Pratt entirely, but it will probably be safe to predict that such a time will not occur until Mr. PEGRAM'S patent shall have expired and engineers will not have to ask permission to use what belongs to some one else.

J. E. GREINER,
Ass't Engineer, Baltimore & Ohio R. R.

"Road Making and Maintenance"—A Charge of Plagiarism.

ST. LOUIS, Mo., Feb. 20, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: We beg leave to call your attention to the following facts: On March 19, 1889, a committee of the Engineers' Society of Western Pennsylvania made a report to that Society on the subject of "Roads," in which the importance of and necessity for good country roads was discussed at length and a draft of a proposed road law submitted for the approval of the Society and its recommendation to the Legislature of the State. This report was duly published by the Society in April, 1889. It was also reissued as part of the final report of the same committee, which was made Jan. 29, 1891 and partially reproduced in ENGINEERING NEWS of Feb. 7, 1891.

In January, 1890, a committee of gentlemen in Philadelphia offered a series of prizes for the best essays on "Road Making and Maintenance." The results of that offer have recently been given to the public in the form of a book, containing the prize essays in full and copious extracts from the other essays submitted.

The extracts from paper No. 15, which appear on pp. 245, 275 and 276 of the book, have been taken bodily from the report of our committee before mentioned. We are also advised by Prof. HAUPT, Secretary to the Commission and editor of the book, that on further investigation he finds that No. 15 had used about 8 pages of our report, without any change other than the omission of names and references.

The book, having been issued from the press, cannot now be corrected, and it will go abroad giving to "No. 15" credit to which he is not entitled. Prof. HAUPT, recognizing the imposture which has been played upon his commission, will take advantage of such occasions as may arise to make public correction of the matter; but in all such cases the wrong outstrips the correction, and it becomes necessary to give to that correction the widest possible circulation. Hence we request you to notice this matter in ENGINEERING NEWS.

We regret that the rules of the competition prevent us from obtaining the name of the party who has thus boldly stolen the matter on which to compete for valuable prizes; but we are credibly informed that he hails from Kirkwood, Mo. Yours truly,

THOS. H. JOHNSON,
For the Committee.

Wellington's Computation from Diagrams of Railway Earthwork.—Correction.

SOUTHERN CENTRAL RY., DAUPHIN, Pa., Feb. 6, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have lately bought Mr. WELLINGTON'S work on the computation of earth work, and in reading his explanation of the use of the diagrams I found a place that I could not understand. After studying awhile I came to the conclusion that either I was very dense or that there was an error in the book. The supposed error is on page 22, where he explains the use of Plate III. by computing the solid shown in Fig. 8. The point is that in reading off the solidity of the second section he gives $C = 9.8$, while in Fig. 8 it is given at 11.8. This last would make the total volume of the solid 1,313 cu. yds. instead of 1,212, as given in the book.

As this error occurs at the first explanation in the book of the use of the diagrams, I have no doubt that it has bothered a great many young engineers like myself. And in the next edition the center height shown in Fig. 8 should be changed.

I find that with the aid of these diagrams one can make an accurate preliminary estimate in less time than by any other method I have ever seen.

GEO. S. SNYDER.

[Our correspondent's correction is correct. The error was noted soon after the first edition was issued, and duly corrected; but in some way the erroneous cut has made its way back again into the page. We may add that, while our correspondent has apparently been using the diagrams for preliminary estimates, their main intended use is for final estimates, for which they save at least 90% of the labor, with a substantial increase of probable accuracy as well.—ED. ENG. NEWS.]

Notes and Queries.

L. Y. S. asks: Can you refer me to any recent conclusions upon the value of creosoted timber in resisting the ravages of the teredo?—We know of nothing better or later than the report of the Am. Soc. C. E. Committee on "Preservation of Timber," Trans. Am. Soc. C. E., Vol. XIV (1885), p. 247.

R. M. P., NEW YORK, asks if a street-sweeping machine is manufactured which gathers its own dust and dirt as it sweeps. In our issue of Sept. 17, 1887, such a machine was described. It was then in the hands of the National Street Sweeping Co., 330 Walnut St., Philadelphia. The cost of sweeping, loading and dumping, at the prices then prevailing for labor, was put at 11.78 cts. per 1,000 sq. yds. of street surface. If there are other machines we would like to hear of them.

PAPIER asks if any gas or water pipes have been made in America of bituminized paper, and where and by whom. State address of firms manufacturing the strongest and heaviest grades of paper.—Will some of our readers reply to these queries? We will add that during the expert examination of electrical conduits for New York streets, bituminized paper and for paper pipes were tested. It was found that both were worthless for carrying gas, as this dissolved the coating. The bitumen pipe carried water very well as long as the pipe was whole. When a cut section of pipe was exposed to water this fluid soaked into it.

ANCIENT SUBSCRIBER wants to be told how to prevent concrete sticking to the wooden forms used in making the tubes for cable railways. We would ourselves be pleased to hear from those having experience in this matter. As showing the affinity of concrete for iron it might be mentioned in this connection that the dredging buckets used by Mr. PACKARD in filling the wells of the Poughkeepsie bridge foundations with concrete were afterward employed in ordinary dredging operations. After over a year's use in sand, gravel, rock, etc., the concrete still stuck to those buckets, seemingly unaffected by the later rough usage. If concrete will stick to wood with anything approaching this tenacity, the problem suggested by our correspondent is a difficult one to solve. Molds made of creosoted timber have been suggested, but we do not know with what result.

SUBSCRIBER asks where cellulose or woodite, mentioned in ENGINEERING NEWS of Oct. 18, 1890, is manufactured, and to whom should he apply in the United States for further information as to properties and cost.—We do not know that it is an article of commerce in the United States. The United States Navy Department, at Washington, D. C., doubtless possesses the fullest information on this subject. Direct to Bureau of Navigation, Office of Naval Intelligence. In "Naval Progress" for 1890, this bureau says that cellulose costs about $350 per ton, but one cubic foot of the ordinary kind weighs only 7½ lbs. The same authority says woodite weighs 14 lbs. per cubic foot and costs about $225 per ton. They do not mention manufacturers, but would doubtless give this information on application.

An Automatic Stock Hoist for Blast Furnaces.

In the operation of a blast furnace the labor employed is principally required for the purpose of keeping the furnace supplied with ore and fuel. A blast furnace producing 100 tons of pig iron per 24 hours, may require, perhaps, 400 tons of ore, fuel, and limestone. Under the almost universal method of working, this is shoveled into two-wheeled hand barrows, holding as much as one man can handle, and is wheeled from the stock house to a vertical elevator beside the furnace stack. At the top it is wheeled from the elevator and dumped into the mouth of the furnace.

Even when the stock house is placed as close as possible to the furnace, the cost of the labor necessary to handle 400 tons of material per day by this method is a considerable item in the expense account of the furnace. But thus far automatic machines for hoisting and handling stock have not been favorably regarded by furnacemen. One main reason for this is that all such arrangements are considered more liable to get out of order than the common vertical hoist. Such repairs as the latter may require can almost always be made in a few minutes; and by accumulating a considerable number of loaded barrows at the top of the stack, no interruption whatever of the furnace's working need be made. But automatic devices are supposed to be necessarily more complicated; and if not more likely to get out of order, they are claimed to be more difficult to repair in case the necessity does arise.

Simplicity and solidity, then, are the first essentials of a successful automatic stock hoist; and to these may be added cheapness in first cost and cost of maintenance. The margin of labor cost to be saved by it is necessarily small, for the loading of the stock on the charging cars or barrows forms a large part of the total labor cost, and this is done by hand, even when the hoist is automatic.

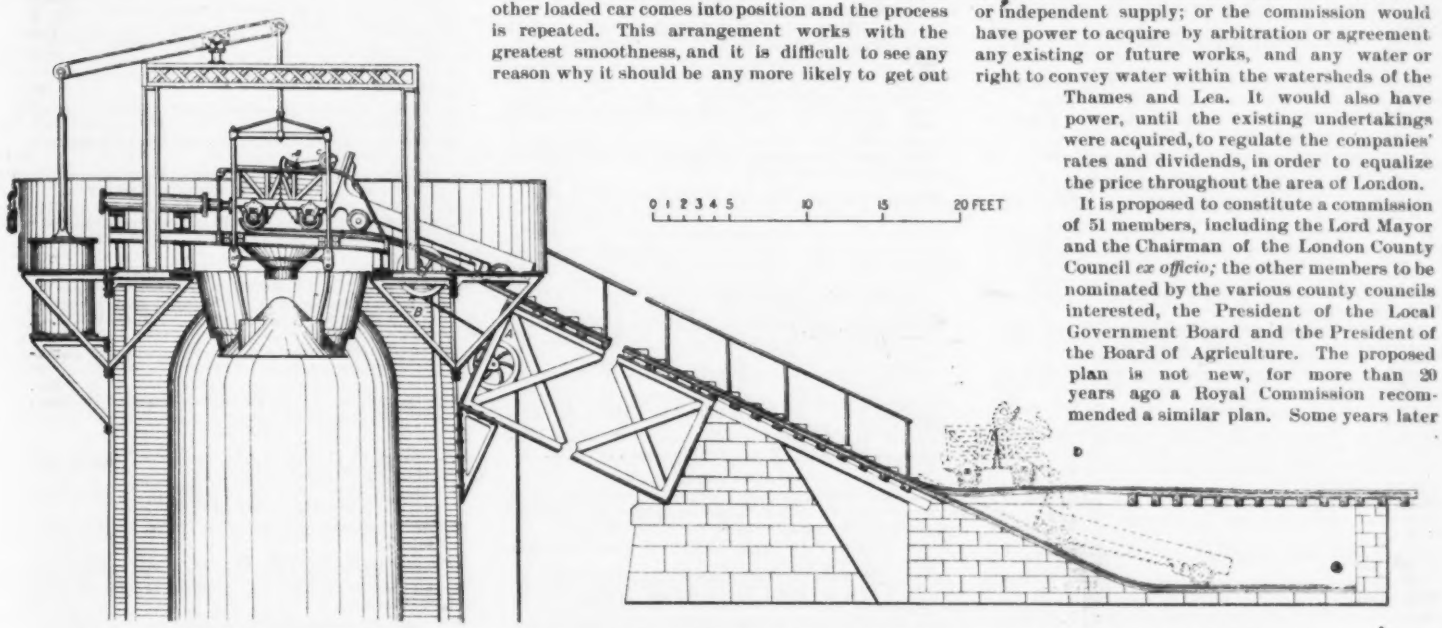
On the other hand the benefit derived from an automatic hoist is not confined to the saving of labor and expense. Each car load of stock is dumped just at the center of the bell and evenly distributed over the top of the furnace, thus mixing the stock more evenly and keeping the top of the furnace charge more regularly covered than is generally possible when the furnace is fed by hand barrow.

The accompanying engraving shows an elevation of an automatic hoist which has been in use for three years at the furnaces of the Pioneer Mining & Manufacturing Co. at Thomas, Ala., about five miles west of Birmingham. The two furnaces at this place are ranked among the best equipped in

the South. They were erected in 1887, and the automatic hoist was built at the same time and has been in use from the start. Mr. EDWIN THOMAS, Vice-President of the company, writes us:

As to the satisfaction it is giving, I would say that we would have no other hoist. It has worked superbly and has not given us one minute's trouble since we started. The cost of operating is much cheaper than with the ordinary hoist, and the furnaces work much more regularly with it.

An elevation of the furnace and hoist is shown in the accompanying engraving. A riveted truss is placed against the furnace stack, inclined at an angle of 25° with the horizontal. This carries a single track, of 30 ins. gage, up which the stock cars run. Inside these rails is a second set of rails of 22 ins. gage, on which the pusher car runs. At the base of the incline the pusher car rails run down into a pit and the stock-car track runs over it. The inclined truss is supported at the base by a solid masonry abutment, which is intended to take up the end thrust of the truss and its load. About half way up it is supported by a pier, made of four latticed columns with considerable batter, and at the top it is supported on brackets riveted to the stack.



AUTOMATIC INCLINED STOCK HOIST AT BLAST FURNACES OF PIONEER MINING & MANUFACTURING CO., THOMAS, ALA.

The hoisting rope runs from the engine house to a sheave *A*, set at any convenient point on the under side of the incline, thence to sheave *B* at the head of the incline, and thence to the pusher car. Under the rear end of the pusher car is a sheave, around which passes a chain, and to this the rope is fastened.

The stock cars are plain four-wheeled cars with wood bodies, and hinged flap bottoms. These are kept closed ordinarily by chains attached to a weighted lever pivoted on the side of the car at *a*, as shown in outline at the bottom of the incline. The cars are of 27 cu. ft. capacity, holding, therefore, something over a ton of limestone, and perhaps two and one-half tons of ore. The coke cars have extension tops and hold 1,650 lbs. of coke.

From the base of the incline the tracks run to the stock houses, where the cars are loaded by hand. The loaded cars are pushed by hand to the foot of the incline, the tracks being laid out with a gentle grade to facilitate movement in this direction. When a loaded car drops into position at the foot of the incline, the pusher car comes up behind it and the buffer of the stock car slides down a channel iron on the front of the pusher car until the forward motion brings the two on the same level. The car is then pushed up to the top of the furnace, and as it passes over the center of the bell the counterweight *c* on the dumping lever strikes the inclined rail and is lifted by it. This releases the flap doors, which form the car bottoms, and the charge is dumped directly on the center of the bell. The engineer on top of the furnace then reverses his engine, and the weight of the pusher car starts it down the incline. The stock car is standing on a level track, however, and a push is necessary to start it down the incline. This is furnished by a compressed air buffer, which is pushed in by the car as it rolls onto the top of the furnace; and as the pusher car starts, the stock car is pushed back by the buffer until it, too, is on the incline and its own weight keeps it against the pusher. The compressed air supply which works this pusher is merely the blast pressure of the furnace, amounting generally to 8 lbs. per sq. in. From the same source power is obtained to work the cylinder at the left which raises and lowers the bell. To further insure the stock car moving off the top of the furnace in close contact with the pusher, two hooks are bolted to the front end of the pusher car. These are brought into position to hold the stock car by the change of angle at the top of the furnace, but are inoperative as soon as the two cars are on the incline.

As the car reaches the foot of the incline, the pusher car rolls down into the pit, and the empty stock car rolls over it toward the stock house; another loaded car comes into position and the process is repeated. This arrangement works with the greatest smoothness, and it is difficult to see any reason why it should be any more likely to get out of order or any more difficult to repair than the ordinary vertical hoist. It may be questioned, indeed, whether it is not superior in simplicity and certainty. It was originally thought that the movement of the buffer on the front face of the pusher car might sometimes cause trouble, and therefore, in the first car used the face of the pusher was made with a series of 2-in. rollers, to facilitate the motion of the buffer. These have been discarded, however, for a plain channel iron, which works perfectly well

The power required to work this hoist is a little greater than with the vertical hoist, since with that the empty cars going down on one cage help to lift the full ones on the other, and the two cages (which correspond to the pusher car) balance each other. But this is of no importance whatever, for the extra steam required is taken from the main boilers, and, of course, costs practically nothing.

The Thomas furnaces were built for a capacity of about eighty tons each per day, but as high as 121 tons in twenty-four hours have been made in one furnace, and its average per day for last year was 113 tons. The total force on each shift at each hoist is one man on top and helper and nine men and one scale man in the stock house. The exact cost of the hoist we have not been able to ascertain, but there seems no reason why it should be much more expensive to build than a first class vertical hoist. Its steady use for three years at the Thomas furnaces, with no failure or trouble whatever, seems to prove pretty well its reliability. These furnaces were among those visited on the Southern excursion of the British Iron and Steel Institute, and the hoists were examined with much interest by both the foreigners and the Americans.

The Water Supply of London.

[FROM AN ENGLISH CORRESPONDENT.]

The population of London and the districts supplied by the water companies is at present about 5,600,000, with an annual increase of about 75,000. The daily consumption is 168,000,000 galls. or 30 galls. per head. There are 8 companies; the Southwark & Vauxhall, West Middlesex, Chelsea, Lambeth, Grand Junction, East London, New River and Kent. The first five obtain water from the river Thames, and supply about 2,800,000 persons; the East London and New River companies obtain their supply from the New River and river Lea, and supply about 2,500,000; the Kent Co. obtains its supply from wells in the Kentish chalk and supplies about 300,000. The corporation of London has a bill now before Parliament to constitute a public authority, known as the London Water Commission, to represent the interests of the consumers and to control the water supply of the whole or a part of the London area, and with power to promote bills authorizing the construction of water works to afford an alternative or independent supply; or the commission would have power to acquire by arbitration or agreement any existing or future works, and any water or right to convey water within the watersheds of the Thames and Lea. It would also have power, until the existing undertakings were acquired, to regulate the companies' rates and dividends, in order to equalize the price throughout the area of London.

It is proposed to constitute a commission of 51 members, including the Lord Mayor and the Chairman of the London County Council *ex officio;* the other members to be nominated by the various county councils interested, the President of the Local Government Board and the President of the Board of Agriculture. The proposed plan is not new, for more than 20 years ago a Royal Commission recommended a similar plan. Some years later a Select Committee of the House of Commons made the same recommendation, and 10 years ago Mr. CROSS, the then Home Secretary, introduced a bill to buy out the companies for $165,000,000, but public opinion was opposed to the expenditure of such a sum, and the scheme was abandoned. Later, another Select Committee was appointed, and recommended that a representative water authority should be constituted, but the government took no steps to carry this out. Under the new bill, the Commission may acquire existing undertakings, or it can furnish additional supplies from Derbyshire or Wales. The latter fact will probably have a considerable effect in making the companies more moderate in their demands. A private scheme has been brought forward for a supply from lakes and rivers in North Wales. The total length of aqueduct would be 163 miles, including 122 miles of masonry conduits or tunnels and 41 miles of 6-ft. steel pipes.

THE CENTER OF POPULATION OF THE UNITED STATES, says the last Census Bulletin, is now in Southern Indiana, a little west of south of Greensburg, the county seat of Decatur County.

A CANAL IS PROJECTED TO CONNECT THE DANUBE AND THE THEISS, says *Le Genie Civil.* The Hungarian Ministers of Agriculture and Commerce have granted to M. MASSALSKY a temporary concession for one year for the construction of this canal from Buda-Pesth to Szegedin, and from Therisiopel to Kula. The scheme is now being surveyed, and before the year expires it is expected that work will be commenced.

Statistics Showing the Prospective Railway Construction of 1891.

(WITH MAP.)

(In the following list it has been our intention to include all lines of railway which have some fair prospect of being completed or placed under contract or construction during the current year. It should not be understood from this that all or nearly all the following lines will probably be put under construction during the coming year, neither do we mean, on the other hand, that the enterprises below described have a mere fighting chance of beginning actual work during 1891. The list presents simply a fair statement of the lines on which engineers and contractors have a prospect of securing work during the coming season. It is presented, of course, with no such claims to accuracy as we make for our maps of actual tracklaying, nor is it by any means so full and accurate as our sectional maps, since it is made up largely from reports made some time ago. It will be found more accurate also, we presume, with regard to independent enterprise than with regard to the extensions of the large systems, erring somewhat by omissions with regard to the latter. Used with these precautions, we trust the map and guide will prove a valuable guide to our engineer and contractor readers in planning the coming season's work. Concerning the many enterprises omitted from the map and list as having little or no prospect for actual work during 1890, we shall be pleased to receive further data giving additional reasons for their inclusion; and in like manner any which may be wrongly included or wrongly described in the following list, we shall be pleased to correct on receipt of well attested data).

NEW ENGLAND.

MAINE.

Aroostook & Penobscot.—Projected, Mattawamkeag to Van Buren, 150 miles. A. A. Burleigh, Houtton.

Castine & Bangor—Projected, Castine to Bangor, 37.7 miles. President, James Adams, Bangor.

Farmington & Gardiner.—Projected, Farmington to Gardiner, 25 miles.

Georges Valley.—Projected, Warren to Union Common, 8 miles Chief Engineer, Henry A. Hancox, Melrose, Mass.

Rumford Falls & Buckfield—Surveyed, Gilbertsville to Rumford Falls, 14.4 miles. President, Wm. L. Putnam, Portland; Chief Engineer, Parker Spofford, Bucksport.

Skowhegan & Norridgewock.—Projected, Skowhegan to Norridgewock, 5.5 miles. Chief Engineer, Frederic Danforth, Gardiner.

Zig-Zag.—Projected, across Peak's Island, near Portland, Me., 1.5 miles. President, Julius Akeroyd, Boston, Mass. Chief Engineer, E. C. Jordon, Portland.

Total.—Surveyed or under survey, 14.4 miles. Projected, 237.7 miles.

NEW HAMPSHIRE.

Concord.—Surveyed. Barnstead to Gilmanton, 6.5 miles, Projected, North Weare to Henniker, 6 miles.

Concord & Montreal.—Projected, Jefferson Hill to Jefferson Meadows, 3 miles.

Moosilauke.—Surveyed, Warren to summit of Moosilauke Mt., 9 5 miles. President, John H. Pearson, Concord.

Portsmouth & Concord.—Surveyed, Greenland to Epping, 13 miles.

Whitefield & Jefferson.—Surveyed, Jefferson to Berlin, 15 miles.

Total.—Surveyed or under survey, 44 miles. Projected, 9 miles.

VERMONT.

Barre.—Under construction, East Barre to quarries, 1.25 miles.

Bristol.—Partly graded, Fairhaven to Richmond, 25 miles. President, Josh. I. Ridley; Chief Engineer, J. M. Fitch; both of Bristol.

Clarendon & Pittsford.—Surveyed, Proctor to Brandon, 13 miles.

Total.—Under contract or construction, 26.25 miles. Surveyed or under survey, 13 miles.

MASSACHUSETTS.

Plymouth & Bournedale.—Surveyed, Plymouth to Bournedale, 22 miles. Chief Engineer, Henry A. Hancox, Melrose.

Plymouth & Middleboro.—Projected, Plymouth to Middleboro, 16 miles. James M. Hodge, Plymouth.

Total.—Surveyed or under survey, 22 miles. Projected, 16 miles.

RHODE ISLAND.

Providence & Springfield.—Projected, Primrose to Woonsocket, 4 miles. Chief Engineer, Wm. Tinkham, Providence.

Woonsocket & Pascoag.—Track laid, Nasonville to Harrisville, 4 miles.

Total.—Under contract or construction, 4 miles. Projected, 4 miles.

CONNECTICUT.

Shepaug, Litchfield & Northern.—Surveyed, Litchfield to Torrington, 6 miles.

Waverly & Jewett City.—Surveyed, Westerly, R. I., to Jewett City, 25 miles. Chief Engineer, Thos. F. Chappelle, Pawtucket, R. I.

Total.—Surveyed or under survey, 31 miles.

MIDDLE ATLANTIC.

NEW YORK.

Adirondack & St. Lawrence.—Surveyed, Valleyfield, P. Q., to Malone, 30 miles. President, Morton S. Parmlee, Malone; Chief Engineer, C. D. Maze, 480 St. James Place, Montreal, P. Q.

Carthage & Adirondack.—Projected, end track to Tuppers Lake, 30 miles.

Chateaugay.—Surveyed, Saranac Lake to Lake Placid, 10 miles.

Cooperstown and Charlotte Valley.—Partly graded, West Davenport to East Davenport, 8 miles.

Croton Valley.—Projected, Croton Point to Connecticut State Line, 25 miles. Chief Engineer, S. L. Moore; General Manager, F. Knowland. Offices 48 Wall St., New York City.

Delaware & Hudson Canal Co.—Under construction, spur on Ticonderoga R. R., 0.32 miles.

Dunderberg Spiral.—Graded, gravity railway at Mt. Dunderberg, 15 miles. Treasurer, J. L. Given, New York City.

Dutchess County.—Partly graded, Poughkeepsie to Hopewell Junction, 12 miles. D. N. Stanton, Yonkers; W. R. Todd, Morristown, N. J.

Elmira, Cortland & Northern.—Surveyed, Camden to Watertown, 59 miles.

Erie & Central New York.—Surveyed, Cortland to Cincinnatus, 18 miles. Frederick Thomas, Cortland.

Herkimer, Newport & Poland.—Projected, Poland, to Jock's Lake, 30 miles.

Lake Shore & Michigan Southern.—Silver Creek & Dunkirk R. R.—Projected, Silver Creek to Dunkirk, 8.5 miles.

Lehigh Valley.—Buffalo & Geneva R. R.—Under construction, Geneva to Buffalo, 98 miles. Geneva & Van Ettenville R. R.—Under construction, Geneva to Van Ettenville, 57 miles.

Lockport & Northern.—Projected, Lockport to New Fane Station, 10 miles. President, Wm. Spaulding, Lockport.

New York Central & Hudson River.—Mohawk & St. Lawrence R. R. Under Survey, Utica to Clayton, 170 miles.

Rome & Carthage.—Surveyed, Rome to Carthage, 56 miles.

Rome, Watertown & Ogdensburg.—Projected, Buffalo to Suspension Bridge, 25 miles.

Rondout Valley.—Surveyed, Summitville to Kingston, 40 miles. President, Isaac N. Cox, Ellenville.

Troy & New England.—Projected, Troy to Lebanon Valley R. R., 35 miles. President, Walter P. Warren, Troy; Wm. B. Thompson, Troy.

Ulster & Delaware.—Partly graded, Bloomville to Oneonta, 22 miles.

Utica & Unadilla Valley.—Partly graded, end of track to New Berlin, 19 miles. President, A. C. Couch, 45 Broadway, New York City.

Total.—Under contract or construction, 231.32 miles. Surveyed or under survey, 383 miles. Projected, 163.5 miles.

NEW JERSEY.

Lake Hopatcong.—Surveyed, Great Notch to Caldwell, 5 miles.

Pennsylvania, Poughkeepsie & Boston.—Projected, Swartswood to Harrisburg, 18.5 miles.

Philadelphia & Seashore.—Under construction, end of track to Sea Isle City, 10 miles. President, Chas. W. Potts, Philadelphia, Pa.

Raritan River.—Under construction, New Brunswick to Bound Brook, 7 miles.

Rockaway Valley.—Surveyed, Peapack to Morristown, 15 miles.

Total.—Under contract or construction, 17 miles. Surveyed or under survey, 20 miles. Projected, 18 miles.

PENNSYLVANIA.

Altoona & Wapsononock.—Under construction, end of track to Fallen Timber, 10 miles. President, T. G. Patterson, Altoona; Chief Engineer, F. L. Faries, Bellwood.

Bush Creek, Pittsburg & New York.—Surveyed, Franklin to Clearfield, 90 miles.

Clarion River.—Under construction, end of track to Hallton, 6 miles. Chief Engineer, B. E. Wellendorf, Ridgway, Pa.

Coudersport & Port Allegheny.—Surveyed, Sweden Valley to Ansonia, 33 miles.

Cumberland Valley.—Surveyed, Fort Loudon to Mt. Dallas, 46 miles.

Delaware River & Lancaster.—Surveyed, Kimberton to Lancaster, 33 miles.

Delaware, Susquehanna & Schuylkill.—Under construction, end of track to Gowen, 29.4 miles. Chief Engineer, Edgar Kudlich, Drifton.

Emmittsburg.—Surveyed, Emmittsburg to Gettysburg, 11 miles.

Gettysburg & Chambersburg.—Under construction, Conocoheague to Caledonia, 6 miles. Chief Engineer, Samuel Culbertson, Chambersburg.

Johnsonburg & Bradford.—Partly graded, Johnsonburg to Bradford, 35 miles. Chief Engineer, J. M. Floesch, Box 466, Erie.

Lackawanna & Montrose.—Partly graded, Montrose to Montrose Station, 10 miles.

Lancaster, Oxford & Southern.—Surveyed. Quarryville to White Rock, 9 miles; Oxford to Singerly, 14 miles. President, Walter M. Franklin; Chief Engineer, S. C. Slaymaker, Lancaster.

Newport & Sherman's Valley.—Surveyed, Newport to North Gilmantown, 30 miles. President, David Gring, Newport.

Pennsylvania.—Graded, Morrisville, N. J., to Downington, 52 miles. Partly graded, Stewarts to Murrysville, 7 miles. Under construction, Palmer to Tranger, 5 miles. Surveyed, Hecla to Mt. Pleasant, 3 miles.

Pennsylvania, Lehigh & Eastern.—Surveyed, Port Jervis to Tombicken, 100 miles.

Pennsylvania, Poughkeepsie & Boston.—Surveyed, Slatington to Harrisburg, 101 miles.

Philadelphia & Reading.—Under construction, Bowmansdale to Harrisburg, 8.76 miles. Under contract, Philadelphia Terminal R. R., 4 miles.

Pittsburg, Shenango & Lake Erie.—Graded, Dixonburg to Girard, 26 miles.

Titusville, Cambridge & Lake Erie.—Partly graded, Titusville to Erie, 50 miles.

Western Maryland.—Surveyed, Porter's Station to Marietta, 25 miles; branch to Bowmansdale, 20 miles.

Western New York & Pennsylvania.—Under contract, Rosse's Crossing to Swan's, 5 miles.

Wilkesbarre & Western.—Under construction, Rohrsburg to Orangeville, 7 miles.

Total.—Under contract or construction, 261.16 miles. Surveyed or under survey, 532 miles.

MARYLAND.

Baltimore & Drum Point.—Partly graded, Baltimore to Drum Point, 82 miles. Chief Engineer, Nicholas Goldsborough, 10 South Broad St., Baltimore.

Baltimore Belt.—Under construction, Camden Station to Bay View Junction, in city of Baltimore, 7 miles. Chief Engineer, Samuel Rea, Baltimore.

Confluence & Oaklaud.—Surveyed, Manor Lands to Oakland, 15 miles. President, J. Bayard Henry, 742 Drexel Building, Philadelphia, Pa.

Deer Creek & Susquehanna.—Projected, Bel Air to Havre de Grace, 25 miles. President, Geo. M. Jewett, Glenville.

Gunpowder Valley.—Under contract, Hoffman to Rockdale, 5 miles. President, G. W. S. Hoffman, 11 South Gay St., Baltimore.

Western Maryland.—Surveyed, Arlington to Colgate Creek, 8 miles.

Total.—Under contract or construction, 94 miles. Surveyed or under survey, 30 miles. Projected, 25 miles.

NORTH CENTRAL.

OHIO.

Baltimore & Ohio.—Track laid, end of track to Akron 39 miles.

Cleveland & Marietta.—Surveyed, Kimballton to Loudonville, 68 miles.

Cleveland Belt.—Under contract, belt line at Cleveland, 7 miles.

Columbus, Lima & Milwaukee.—Partly graded. Lima to Defiance, 40 miles. President, B. C. Faurot, Lima.

Findlay Belt.—Under construction, around city of Findlay, 20 miles. Horace Paul, Findlay.

Findlay, Ft. Wayne & Western.—Partley graded, Glandorf to Ft. Wayne, Ind., 55 miles.

Lake Erie & Western.—Projected, Minister to Piqua, 23 miles.

Lancaster & Hamden.—Under construction, Laurelville to Wellston, 37 miles. E. P. Buell & Co., Tarlton.

Middletown & Cincinnati.—Under construction, end of track to Kings Station, 11 miles.

Ohio Valley.—Under construction, Bellaire south, 15 miles. Surveyed, and of grade to Marietta, 55 miles.

Sandusky, Columbus, Lima & Milwaukee.—Located, Sandusky to Columbus, 108 miles. President, John McKilvey; Chief Engineer, Chas. A. Judson; both of Sandusky.

Tiffin & Fremont.—Located, Marblehead to Upper Sandusky, 75 miles. President, J. A. Sloan, Lakeside.

Toledo, Columbus & Cincinnati.—Partly graded. Kenton to Marysville, 35 miles. Chief Engineer, J. C. Williams, Kenton.

Zanesville Terminal.—Under construction, at Zanesville. Chief Engineer, E. S. Lawrence, Zanesville.

Total.—Under contract or construction, 243.3 miles. Surveyed or under survey, 306 miles. Projected, 20 miles.

INDIANA.

Cleveland, Cincinnati, Chicago & St. Louis.—Located, Harrison, O., to Richmond, 39 miles.

Ft. Wayne, Terre Haute & Southwestern.—Under construction, Bainbridge to Carbon, 30 miles.

Ohio & Mississippi.—Surveyed, end of track to quarries, 2 miles.

Rochester, Rensselaer & St. Louis.—Projected, Rochester, Ind., to Gilman, Ill., 100 miles. President, John K. Lee, St. Louis, Mo. Chief Engineer, Burr P. Noland, Winamac.

Wabash.—Projected, Butler to Hammond, 165 miles.

Total.—Under contract or construction, 50 miles. Surveyed or under survey, 41 miles. Projected, 230 miles.

MICHIGAN.

Chicago & West Michigan.—Projected, Traverse City to Charlevoix, 62 miles.

Escanaba, Iron Mt. & Western.—Graded, Iron Mt. to Florence, Wis., 15 miles.

Grand Rapids & Indiana.—Projected, Ludington to Big Rapids, 42 miles.

Grand Rapids, Chicago & St. Louis.—Projected, Grand Rapids to Benton Harbor, 80 miles. Vice-President, Chas. E. Temple, Grand Rapids.

Iron Range & Huron.—Located, Aroon to Champion, 35 miles. President, C. H. Buhl, Detroit, Chief Engineer, Milo Davis, Aroon.

Manistee & Grand Rapids.—Partly graded, Sable River south, 25 miles. Chief Engineer, G. W. Meunscher, Manistee.

Manistee & Northeastern.—Under construction, end of track to Manistee, 33 miles.

Total.—Under contract or construction, 63 miles. Surveyed or under survey, 35 miles. Projected 184 miles

ILLINOIS.

Belleville & St. Louis.—Under construction, East St. Louis to Belleville, 13.5 miles. President, Wm. A. Andrews; Chief Engineer, Wm. A. Rice; both of St. Louis.

Centralia & Chester.—Located, Oakdale to Centralia, 25 miles.

Chicago & Eastern Illinois.—Surveyed, Tuscola to Shelbyville, 40 miles.

Indianapolis, Decatur & Western.—Projected, Decatur to Beardstown, 81.7 miles.

Total.—Under contract or construction, 13.5 miles Surveyed or under survey, 65 miles. Projected, 116.7 miles.

WISCONSIN.

Illinois Central.—Under contract, Madison to Portage, 40 miles.

Kickapoo Valley & Northern.—Surveyed, Wauzeka to Wilton, 80 miles. President, E. I. Kidd, Prairie du Chien.

Milwaukee Belt & Terminal.—Surveyed in and around city of Milwaukee, 50 miles. President, Frederick W. Kalbfleisch, 36 New St., New York City.

Milwaukee, Lake Shore & Western.—Surveyed, Warsaw to Marshfield, 41 miles.

Sault Ste. Marie & Southwestern.—Projected, Mondovi to Alma, 20 miles.

Wisconsin Central.—Partly graded, north of Greenwood, north 12 miles.

Total.—Under contract or construction, 77 miles. Surveyed or under survey, 171 miles. Projected, 20 miles.

SOUTH ATLANTIC.

VIRGINIA.

Atlantic & Danville.—Under construction, Bristol, Tenn., east, 27 miles. Under survey, end grade to Danville, 148 miles.

Bedford & James River.—Surveyed, Bedford City to James River, 20 miles. Secretary, W. S. McKenney, Bedford.

Charlottesville & Southern.—Projected, Charlottesville to James River, 24 miles. President, R. P. Valentine, Charlottesville.

Chesapeake & Ohio.—Under construction, between Eagle Rock and New Castle, 20 miles. Under contract, Covington to Hot Springs, 20 miles.

Farmville & Powhatan.—Located, Farmville to Hampden, Sidney College, 7 miles.

Louisville & Nashville.—Under construction, end of track to Big Stone Gap, 40 miles.

Norfolk & Western.—Under construction, Great Outpurst to North Carolina line, 20 miles. Projected, Front Royal to Washington, 70 miles.

Richmond & Chesapeake.—Projected, Richmond to Wicomico, 50 miles.

Roanoke & Southern.—Under construction, North Carolina line to Roanoke, 6) miles.

Staunton Development Co.—Under construction, line to mines, 2 5 miles.

Total.—Under contract or construction, 184.5 miles. Surveyed or under survey, 175 miles. Projected, 144 miles.

WEST VIRGINIA.

Baltimore & Ohio.—Surveyed, Morgantown to Uniontown, Pa, 33 miles.

Bluefield & Princeton.—Surveyed, Bluefield to Princeton, 19 miles. Chief Engineer, H. S. Lamble, Roanoke, Va.

Norfolk & Western.—Under construction, Forks of Elkhorn to Ironton, O., 170 miles.

Ohio River.—Graded, Ravenswood to Spencer, 25 miles.

Western Maryland.—Surveyed, Williamsport, Md., to Cherry Run, 14 miles.

West Virginia & Pittsburg.—Under construction, Burnsville to Braxton, 18 miles; Shelbyville south, 25 miles.

West Virginia Central.—Projected, Elkins south, 25 miles.

Total.—Under contract or construction, 238 miles. Surveyed or under survey, 33 miles. Projected, 25 miles.

NORTH CAROLINA.

Asheville & Bristol.—Under contract, Asheville to Bristol, Elizabethtown & North Carolina R.R., 55 miles. Chief Engineer, H. M. Ramseur, Hendersonville.

Asheville & Craggy Mt.—Under construction, Asheville to Craggy Mt., 4 miles. President, W. B. Gwyer, Asheville.

Atlantic Coast Line.—Under construction, Fayetteville to Rowland, 40 miles. Projected, Kingston to Jacksonville, 35 miles; Greenville to Washington, 20 miles; Springhope to Durham, 45 miles.

Cape Fear & Cincinnati.—Surveyed, Conway, S. C., to Wilmington, 85 miles. President, Frank Brown; Chief Engineer, Geo. B. Morton; both of Baltimore.

Cape Fear & Yadkin Valley.—Graded, Mt. Airy to Virginia line, 9.5 miles.

Charleston, Cincinnati & Chicago.—Partly graded, Rutherfordton to Tennessee line, 95 miles.

Charleston, Wilmington & Northern.—Projected, Charleston, S. C., to Wilmington, 160 miles. President, J. C. McNaughton; Chief Engineer, John Runk; both of 228 Dock St., Philadelphia, Pa.

Cranberry & Linville.—Projected, Cranberry to Linville, 13 miles. President Hugh MacRae; Chief Engineer, J. R. Irwin; both of Linville.

Crawfish Springs & Roan Mt.—Under construction, Crawfish Springs to Roan Mt., 4 miles.

French, Broad Valley.—Under construction, Asheville to South Carolina line, 60 miles; Mills River to Rutherfordton, 40 miles. Chief Engineer, H. M. Ramseur, Hendersonville.

Richmond & Danville.—Under construction, Tomotla to Murphy, 5 miles; Bilesville to Norwood, 17 miles. Partly graded, Winston to main line, 55 miles. Surveyed, Winston to Danville, 70 miles.

Roanoke & Southern.—Under survey, Winston to Monroe, 85 miles.

Southern & Western Air Line.—Partly graded, Shelby north, 23 miles.

Thomasville, Silver Valley & Pee Dee.—Surveyed, Winston to Wadesboro, 99.25 miles. President, Jas. T. Cramer; Chief Engineer, C. W Pearson; P. C. Thomas, Thomasville.

Wilmington, Onslow & East Carolina.—Under survey, Jacksonville to New Berne, 38 miles.

Total.—Under contract or construction, 407.3 miles. Surveyed or under survey, 342.25 miles. Projected, 163 miles.

SOUTH CAROLINA.

Cape Fear & Cincinnati.—Under contract, Gaffney City to Broad River, 25 miles. Chief Engineer, C. H. Ragsdale, Lancaster.

Carolina, Knoxville & Western.—Surveyed, end of track north, 35 miles. Jas. I. Williams, Greenville.

Charleston, Cincinnati & Chicago.—Partly graded, Black's to Newberry, 70 miles. Chief Engineer, A. N. Molesworth, Johnson City, Tenn.

Charleston, Sumter & Northern.—Under construction, 6 miles south of Bennettsville to Sumter, 56.3 miles.

South Bound.—Under construction, Monteith, Ga., to Columbia, 134 miles.

Total.—Under contract or construction, 258.3 miles. Surveyed or under survey, 70 miles. Projected, 110 miles.

GEORGIA.

Abbeville & Way Cross.—Partly graded, Bowen's Mills to Swan, 10 miles. President, J. D. Maynard; Chief Engineer; both of Abbeville.

Albany, Boston & Florida.—Projected, Albany to Madison, Fla., 90 miles. President, M. R. Mallette; J. W. Taylor; both of Boston, Ga.

Albany, Florida & Northern.—Track laid, end of track to Cordele, 15 miles.

Atlanta & Alabama.—Surveyed, Atlanta to Selma, Ala., 180 miles. President, H. B. Tompkins; L. E. O'Keefe; both of Atlanta.

Augusta & West Florida.—Partly graded, Augusta southwest, 25 miles. President, C. E. Smith, Augusta.

Belton, Homer & Carnesville.—Surveyed, Bellton to Carnesville, 25 miles. President, M. Buice, Covington.

Chattanooga, Rome & Columbus.—Projected, Carrolton to Columbus, 80 miles.

Dahlonega & Dawsonville.—Surveyed, Tate to Lulu Junction, 65 miles. President, President, P. B. Lawrence, Dahlonega.

Empire & Dublin.—Partly graded, Hawkinsville to Grovania, 13 miles.

Georgia Southern & Florida.—Located, La Grange to Birmingham, Ala., 135 miles; Tipton to Thomasville, 52.8 miles.

Georgia, Tennessee & Illinois.—Projected, Tallapoosa to Stevenson, Ala., 125 miles. President, Benj. F. Butler, Boston, Mass.; Chief Engineer, L. F. Bellinger, Tallapoosa.

Macon & Atlantic.—Partly graded, Macon to Atlantic coast, 180 miles. Chief Engineer, Wm. H. Wells, Macon.

Macon, Dublin & Savannah.—Under construction, end of track to Dublin, 44 miles. President, D. M. Hughes; Chief Engineer, D. B. Dunn; both of Macon.

Middle Georgia & Atlantic.—Under construction, Newberne to Covington, 6 miles. Chief Engineer, L. W. Robert, Monticello. Partly graded, Newberne to Social Circle, 10 miles.

Millen & Southern.—Graded, Thrift to Millen, 11 miles. President, Loring B. Miller, 16 Beaver St., New York City.

Seaboard Air Line.—Under construction, Savannah River to Atlanta, 110 miles.

Talbotton & Western.—Projected, Waverly Hall to Flint River, 30 miles. W. H. Martin, Talbotton.

Way Cross Air Line.—Projected, end of track to Cordele, 83 miles. President, Loring B. Miller, 16 Beaver St., New York City; Chief Engineer, J. E. Sloan, Cordele.

Wrightsville & Tennile.—Surveyed, Dublin to Abbeville, 50 miles. President, W. B. Thomas, Abbeville.

Total.—Under contract or construction, 456 miles. Surveyed or under survey, 215 miles. Projected, 308 miles.

FLORIDA.

Florida, Midland & Georgia.—Under construction, Valdosta, Ga., to Deadman's Bay, 85 miles. President, J. M. Wilkinson; Chief Engineer, Arthur Pow, both of Valdosta.

Palatka & Anclote.—Partly graded, Palatka south, 18 miles.

Total.—Under contract or construction, 88 miles. Projected, 15 miles.

SOUTH CENTRAL.

KENTUCKY.

Bowling Green & Northern.—Located, Bowling Green to Chesapeake, Ohio & Southwestern R. R., 50 miles. Secretary, M. H. Crump, Bowling Green.

Charleston, Kentucky & Western.—Projected, Newport to Mt. Sterling, 92 miles. J. W. Hedden, Mt. Sterling.

Chicago, Evansville & Chattanooga.—Surveyed, Evansville, Ind., to Bowling Green, 90 miles. Chief Engineer, A. B. Fitch, Terre Haute, Ind.; J. E. Williams, Evansville.

Hartford & Fordsville.—Projected, Hartford to Fordsville, 19 miles. President, T. J. Smith, Hartford.

Kentucky Midland.—Projected, Paris east, 32 miles.

Kentucky Union.—Partly graded, Kentucky River to Jackson, 18 miles.

Louisville & Southeastern.—Surveyed, Louisa to Norfolk & Western R. R., 40 miles. President, H. E. Huntington; Chief Engineer, B. F. Thomas; Jay H. Northup, Ashland.

Louisville Southern.—Under construction, Richmond to Beattyville, 58.3 miles.

Ohio & Big Sandy.—Surveyed, Richardson to Pocahontas, Va., 80 miles.

Total.—Under contract or construction, 76.3 miles. Surveyed or under survey, 270 miles. Projected, 143 miles.

TENNESSEE.

Birmingham, Jackson & Kansas City.—Surveyed, Jackson to Fowlkes, 45 miles. President, Clifton Dacy; Chief Engineer, J. J. Williams; both of Jackson.

Bristol, Elizabethtown & North Carolina.—Under construction, Bristol to Mountain City, 75 miles. President, W. D. Haynes; Chief Engineer, Geo. S. Bruce; both of Bristol.

Decatur, Chesapeake & New Orleans.—Partly graded, Booneville to near Shelbyville, 80 miles.

East Tennessee, Virginia & Georgia—Johnsonville & Carolina R. R.—Under construction, end of track east, 11 miles.

Genesis & Obed River.—Partly graded, Johnson's Stand to Crossville, 18 5 miles.

Knoxville & Northern.—Partly graded, Knoxville to Dandridge, 30 miles. Chief Engineer, W. A. Park, Knoxville.

Louisville & Nashville.—Under construction, Clarksville to Dickson, 35 miles.

Missouri, Tennessee & Georgia.—Located, Hickman, Ky., to Humboldt, Tenn., 85 miles.

Morristown & Cumberland Gap.—Under construction, Morristown to Cumberland Gap, 40 miles. President, J. G. Martin; Chief Engineer, Chas. J. Allison; both of Morristown.

Nashville & Knoxville.—Located, Cookville to Cumberland Plateau, 18 miles; branch north, 15 miles.

Paducah, Tennessee & Alabama.—Track laid, Kentucky line to Paris, 18 miles. Surveyed, Paris to Hollow Rock, 15 miles.

Raleigh Springs.—Partly graded, Memphis to Raleigh, 11 miles. President, John Ferguson, Memphis.

Tennessee Midland.—Located, Perryville to Nashville, 92 miles.

Total.—Under contract or construction, 328.5 miles. Surveyed or under survey, 311 miles.

ALABAMA.

Alabama Midland.—Under construction, Rutledge to Julien, 4 miles.

Birmingham & Jones Valley.—Under construction, Avondale to St. Clair Springs, 28 miles. President, C. O. Lagenfelt, Birmingham.

Birmingham, Sheffield & Tennessee River.—Surveyed, South Parish to Warrior River, 20 miles.

Blue Mountain Mineral.—Under construction, Anniston to East & West Ry. of Alabama, 20 miles. J. A. Gaboury, Jacksonville.

Central R. R. of Georgia.—Under construction, Troy to Andalusia, 90 miles.

Chattanooga Southern.—Under construction, between ends of track, 47 miles.

Columbia, Geneva & Western.—Projected, Columbia to Geneva, 5? miles. President, John T. Davis; Chief Engineer, H. L. Cullier; both of Geneva.

Decatur, Chesapeake & New Orleans.—Under construction, between Decatur and Tennessee, line 18 miles.

East Tennessee, Virginia & Georgia.—Projected, Rome, Ga., to Decatur, 70 miles.

Escanaba.—Projected, end of track to Weatherford, 33 miles. President, M. H. Sullivan. Flomaton.

Florence Northern.—Partly graded, Florence, north, 25 miles. Located, end of grade to Linden, Tenn., 51 miles.

Fort Payne & Eastern.—Projected, Fort Payne to Rome, Ga., 35 miles.

Guntersville, Shelby & Montgomery.—Projected, Gadsden to Montgomery, 175 miles.

Montgomery, Tuscaloosa & Memphis.—Under construction, Montgomery to Tuscaloosa, 107 miles.

Piedmont, Luray & Birmingham.—Under construction, east of track to Piedmont, 10 miles.

Savannah, Americus & Montgomery.—Under construction, Georgia line to Montgomery, 75 miles.

Tennessee & Coosa.—Under construction, end of track to Guntersville, 6 miles.

Tennessee River, Asheville & Coosa.—Surveyed, Asheville to Coosa River, 8 miles. Chief Engineer, J. M. J. McKennan, Asheville.

Total.—Under contract or construction, 420 miles. Surveyed or under survey, 293 miles. Projected, 438 miles.

MISSISSIPPI.

Georgia Pacific.—Surveyed, Hopson's Bayou to Helena, Ark., 45 miles.

Memphis & Atlantic.—Surveyed, West Point to Houston, 30 miles. President, F. M. Abbott; Chief Engineer, Belton Mickle; both of West Point.

Mississippi Central Valley.—Surveyed. Rosedale to Bogue Phalia, 6.5 miles. President, Chas. Scott, Rosedale.

Mobile, Jackson & Kansas City.—Located, Mobile, Ala., to Brandon, 184 miles. President, H. Austill; Chief Engineer, T. W. Nicol; both of Mobile, Ala.

Nashville & Mississippi Delta.—Surveyed, Okalona, to Grenada, 60 miles. Chief Engineer, John S. Foster Okalone.

South, Mississippi.—Projected, Natchez to Meridian, 180 miles. President. J. S Solomon, Meridian.

Total.—Surveyed or under survey, 300.5 miles. Projected, 180 miles.

LOUISIANA.

Bayou La Fourch Central.—Projected, St. James to Lake Verret, 20 miles. President, Joseph Maille, New Orleans.

Kansas City, Watkins & Gulf.—Under construction, Alexandria to Spring Creek, 90 miles. Surveyed, Spring Creek to end of track, 30 miles. Chief Engineer, P. H. Philbrick, Lake Charles.

Louisana Nickel Plate.—Surveyed, Houghton north, 10 miles. W. G Wadley, Houghton.

Louisiana & Northwest.—Surveyed, Bienville to Alexandria, 90 miles.

Missouri Pacific.—Graded, Riverton to Alexandria, 75 miles.

New Orleans & Northwestern.—Partly graded, Rayville to Bastrop, 25 miles. Chief Engineer, W. D. Jenkins, Natchez.

New Orleans, Ft. Jackson & Grand Isle.—Surveyed, Pocola Canal to Fort Jackson, 25 miles. Chief Engineer, Chas. S. Dwight, New Orleans.

Total.—Under contract or construction, 153 miles. Surveyed or under survey, 223 miles. Projected, 20 miles.

SOUTHWESTERN.

ARKANSAS.

Camden & Alexandria.—Under construction, Camden to Alexandria, La., 170 miles. President, C. C. Henderson, Camden.

Camden, Louisiana & Sabine Pass.—Projected, Camden to Louisiana line, 50 miles. President, Asa S. Morgan; Chief Engineer, J. Victor Pedron; both of Camden.

Kansas City, Arkansas & New Orleans.—Partly graded, Stuttgart south, 35 miles.

Louisiana, Arkansas & Missouri.—Surveyed, Amburns to Delhi, La., 55 miles. President, Harlow M. Hoyt 58 William St., New York City.

Magnolia & Southern.—Projected, Magnolia to Louisiana line, 25 miles. President, T. J. Elmore; Chief Engineer, E. Elmore; both of Magnolia.

Mississippi & Little Rock.—Under construction, between Duncan and Little Rock, 61 miles.

Stuttgart & Arkansas River.—Under contract, De Witt to Pendleton, 20 miles.

Total.—Under contract or construction, 163 miles. Surveyed or under survey, 177 miles. Projected, 75 miles.

MISSOURI.

Cape Girardeau & Southwestern.—Projected, Hunter to Mammoth Springs, 40 miles. Under survey, Cape Giraudeau to New Madrid, 55 miles.

Chicago, Kansas City & Texas.—Located, Smithville to Gower, 16 miles.

Greenfield & Northern.—Under construction, South Greenfield to Mt. Vernon, 36 miles.

Kansas City Link.—Surveyed, belt Line at Kansas City, 27 miles.

Kansas City Suburban Belt.—Projected belt line at Kansas City, 8 miles. Chief Engineer, J. W. Heylman, Kansas City.

Missouri Pacific.—Under survey, Joplin to Bald Knob, Ark., 200 miles.

Springfield, Marshall, Sedalia & Northern.—Under survey, Springfield to Marshall, 140 miles. Chief Engineer, A. M. Nelson, Springfield.

Total.—Under contract or construction, 36 miles. Surveyed or under survey, 378 miles. Projected, 48 miles.

TEXAS.

Alexandria, Tyler & Northwestern.—Projected, Tyler to Gainesville, 140 miles. President, Richard B. Hubbard, Tyler; Chief Engineer, B. F. Wathen, Dallas.

Aransas Pass Transit.—Under construction, Rockport to light-house, 9.5 miles. President, John H. Taylor; Chief Engineer, B. S. Wathen; both of Dallas.

Austin & Northwestern.—Under contract, Austin to Colorado River, 4 miles.

Corpus Christi & South American.—Under construction, Corpus Christi to Brownsville, 150 miles. President, E. H. Roper, Corpus Christi.

Denison, Bonham & New Orleans.—Partly graded, Denison to Bonham, 28 miles.

Fort Worth & Rio Grande.—Under construction, at Fort Worth, 1.5 miles. Under survey, Comanche to Brownwood, 25 miles.

Gainesville, Henrietta & Western.—Projected, Henrietta to Archer City, 30 miles. Francis Fuller, Galesburg, Ill.

Georgetown & Granger.—Surveyed, Georgetown to Granger, 15 miles. President, Emery Taylor, Georgetown.

Houston Belt.—Projected, belt line at Houston, Tex., 15 miles.

Missouri, Kansas & Texas.—Partly graded, Smithville to Lockhart, 36 miles; Boggy Tank to Sealy, 27 miles.

St. Louis, Arkansas & Texas.—Projected, Rockland to Lufkin, 32 miles.

San Antonio & Aransas Pass.—Partly graded, Waco Branch, 65 miles.

Sherman, Denison & Dallas.—Projected, Sherman to Dallas, 80 miles.

Waco, Lampasas & Llano.—Under construction, Llano to Lampasas, 40 miles. Surveyed, Lampasas to Waco, 100 miles. Chief Engineer, C. A. Gilchrist, Waco.

Total.—Under contract or construction, 361 miles. Surveyed or under survey, 150 miles. Projected, 297 miles.

KANSAS.

Burlington & Missouri River.—Surveyed, Oberlin to Pueblo, Colo.

Topeka, Westmoreland & Marysville.—Partly graded, Topeka north, 55 miles. Chief Engineer, Robert Gates, North Topeka.

Total.—Under contract or construction, 55 miles. Surveyed or under survey 130 miles.

INDIAN TERRITORY.

Chicago, Rock Island & Pacific.—Surveyed, Minco south, 50 miles.

Choctaw Coal & Railway Co.—Under construction, between McAlester and Fort Reno, 140 miles.

Total.—Under contract or construction, 140 miles. Surveyed or under survey, 50 miles.

COLORADO.

Denver & Resort.—Surveyed, Denver to Resort, 17 miles. President, H. A. W. Tabor, Denver.

Denver & Rio Grande.—Projected, Denver to Leadville, 115 miles.

Georgetown, Silver Creek & Chicago Lakes.—Under construction, Georgetown to mines, 10 miles. President, Geo. W. Hall, Georgetown.

Golden & Denver.—Located, Golden to Denver, 22.7 miles.

Rio Grande Southern.—Located, Telluride to Durango, 160 miles. Chief Engineer, C. W. Gibbs, Silverton.

Total.—Under contract or construction, 10 miles. Surveyed or under survey, 361.2 miles. Projected, 115 miles.

NEW MEXICO.

Kansas City, El Paso & Mexican.—Under contract, Lanoria, Tex., to New Mexico line, 10 miles.

Pecos River.—Projected, Eddy to Roswell, 95 miles. President, J. J. Hagerman, Colorado Springs.

Rio Grande & Utah.—Surveyed, Algodones to Durango, 160 miles.

Santa Fe Southern.—Surveyed, Santa Fe to San Pedro, 49 miles.

Sonora, Sinaloa & Chihuahua.—Partly graded, Deming to International line, 30 miles. Loren Miller, Deming.

Total.—Under contract or construction, 30 miles. Surveyed or under survey, 199 miles. Projected, 95 miles.

NORTHWESTERN.

IOWA.

Chicago, Ft. Madison & Des Moines.—Projected, Collett to Ottumwa, 25 miles.

Chicago, St. Paul & Kansas City.—Projected, Des Moines to Omaha, 120 miles.

Sioux City & Northwestern.—Surveyed, Sioux City to Niobrara, 80 miles. Chief Engineer, L. F. Wakefield, Sioux City.

Total.—Under contract or construction, 40 miles. Surveyed or under survey, 5 miles. Projected, 145 miles.

MINNESOTA.

Duluth & Southern.—Under contract, Duluth, southwest, 25 miles. President, J. W. Hoyt, Red Wing.

Duluth & Winnipeg.—Under construction, Cloquet to Duluth, 16 miles.

Duluth, Iron Range & Southern.—Projected, Tower to International line, 20 miles.

Duluth, Mesabi & Northern.—Surveyed, Duluth northwest, 25 miles. President, K. D. Chase, Faribault.

Duluth Transfer.—Located, Duluth to Fond du Lac, 25 miles. President, Albert Harrington, Duluth.

Wadena & Park Rapids.—Under construction, Eagle Bend to Park Rapids, 55 miles. President, Wm. Crooks, Wadena.

Winona & Southwestern.—Under contract, Spring Valley to Mason City, Ia., 55 miles.

Total.—Under contract or construction, 96 miles. Surveyed or under survey, 50 miles. Projected, 20 miles.

NEBRASKA.

Fremont & Yankton.—Projected, Fremont to Yankton, S. Dak., 115 miles. President, J. W. Love, Fremont.

Niobrara & Sioux Reservation.—Surveyed, Verdigris to Niobrara, 12 miles. Chief Engineer, Sanford Horton, Niobrara.

Pacific Short Line.—Under contract, O'Neill to Ogden, Utah, 805 miles.

Total.—Under contract or construction, 280 miles. Surveyed or under survey, 87 miles. Projected, 115 miles.

NORTH DAKOTA.

Minneapolis, St. Paul & Sault Ste. Marie.—Projected, Boynaton to Bismarck, 125 miles.

Northern Pacific.—Projected, Driscoll to McKenzie, 10 miles.

Total.—Under contract or construction, 16 miles. Projected, 135 miles.

SOUTH DAKOTA.

Burlington & Missouri River.—Track laid, end track to Deadwood, 25.2 miles. Under survey, Minnekahta to Hot Springs, 10 miles.

Dakota, Wyoming & Missouri River.—Surveyed, Rapid City to Hill City, 30 miles. President, Wm. T. Coad; Chief Engineer, Chas. J. Howell; both of Rapid City.

Deadwood Central.—Graded, between Deadwood and Ruby, 7.5 miles.

Duluth, Pierre & Black Hills.—Under contract, Oakes, N. Dak., to Pierre, 181 miles. Chief Engineer, B. P. Telden, Aberdeen.

Midland Pacific.—Surveyed, Sioux Falls to Pierre, 221 miles. President, Samuel L. Tate, Sioux City.

Total.—Under contract or construction, 197.7 miles. Surveyed or under survey, 207 miles.

WYOMING.

Burlington & Missouri River.—Partly graded, end of track northeast, 50 miles.

Total.—Under contract or construction, 475 miles.

MONTANA.

Great Northern.—Under construction, end of track west, 300 miles. Surveyed end of grade to Pacific coast, 350 miles. Projected, Monarch to White Sulphur Springs, 50 miles.

Northern Pacific.—Surveyed, Livingston to Castle, 50 miles.

Total.—Under contract or construction, 300 miles. Surveyed or under survey, 200 miles. Projected, 100 miles.

PACIFIC.

CALIFORNIA.

California & Nevada.—Partly graded, Oakland to Walnut Creek, 15 miles.

Lakeport & Ukiah.—Projected, Lakeport to Ukiah, 32 miles. D. S. McDougle, Lakeport.

Los Angeles Terminal.—Surveyed, San Pedro to Hueneme, with branches to Pasadena, Altadena and Long Beach, 140 miles. President, B. T. Hobart, St. Louis, Mo.

Nevada.—California—Oregon.—Located, Ameda to Madeline Plain, 44 miles. E. Gest, Reno.

Pajaro Valley.—Surveyed, end of track to Salinas, 8 miles.

San Francisco & North Pacific.—Projected, Ukiah to Capello, 6 miles; Guerneville Branch to Redwoods, 3 miles.

San Francisco & San Joaquin Valley.—Partly graded, Antioch south, 70 miles. President, J. R. Wilber, San Francisco.

Southern Pacific.—Under construction, Avon to San Ramon, 21 miles. Surveyed, extension of Los Banos Branch south, 50 miles; Elwood to Santa Margarita, 75 miles.

Total.—Under contract or construction, 106 miles. Surveyed or under survey, 242 miles. Projected, 41 miles.

OREGON.

Astoria & South Coast.—Surveyed, end of track to Hillsboro, 81 miles.

Baker City & Sumter Valley.—Surveyed, Baker City to Sumter Valley, 25 miles.

Coos Bay, Roseburg & Eastern.—Under construction, Marshfield to Roseburg, 95 miles. W. B. King, Marshfield.

Oregon & Washington Territory.—Partly graded, Union to Elgin, 29 miles.

Oregonian.—Partly graded, Coburg to Jasper, 13 miles.

Siuslaw & Eastern.—Surveyed. Eugene to Florence, 50 miles. President, A. G. Hovey; Chief Engineer, Alfred Kirkland; both of Eugene.

Umpqua River R. R. & Improvement Co.—Surveyed, Drain to Coös Bay, 75 miles. President, John C. Drain; Chief Engineer, Henry Thielsen, Portland.

Total.—Under contract or construction, 137 miles. Surveyed or under survey, 231 miles.

WASHINGTON

Ellensburg & Northeastern.—Partly graded, Ellensburg to Port Eaton, 40 miles. Chief Engineer, Hubert C. Ward, Tacoma.

Fidalgo City & Anacortes.—Projected, Fidalgo City to Mt. Vernon and Bay View, 35 miles.

Great Northern.—Under construction, Seattle to Fairhaven and Southern R. R., 77 miles.

Horace Steam & Navigation Co.—Under survey, Stouts to Frankfort, 10 miles. Chief Engineer, R. E. Habersham, Portland.

Northern Pacific.—Graded, end of track to Acosta, 28.1 miles. Partly graded, Black River Junction north, 20 miles. Under construction, Chehalis to South Bend, 54 miles; end of track to Harlowe Junction, 18.4 miles. Located, end of track to Niblocks, 13 miles. Projected, Sand Coulee west, 25 miles; Anacortes to mines, 5 miles.

Oregon & Washington Territory.—Partly graded, Centralia to Gray's Harbor, 60 miles. Surveyed, Portland to Hunts Junction, 220 miles.

Port Angeles Central.—Located, Port Angeles south, 10 miles. President, Jas. Wickersham, Tacoma.

Port Townsend Southern.—Located, Lake Hooker to Olympia, 70 miles.

Seattle Northern.—Track laid, end of track to Hamilton, 7 miles.

Spokane Falls & Northern.—Surveyed, Marcus to Lake Osoyoos, 100 miles.

Spokane & Northwestern.—Under survey, Tacoma to Port Angeles, 100 miles. President, Frank C. Ross; Engineers, Ogden & Bosworth; both of Tacoma.

Union Pacific.—Partly graded, Portland, Ore., to Seattle, Wash., 185 miles.

Vancouver, Klickitat & Yakima.—Projected, end of track north, 10 miles.

Total.—Under contract or construction, 489.5 miles. Surveyed or under survey, 913 miles. Projected, 75 miles.

UTAH.

Castle Valley.—Partly graded, Price, south, 50 miles. President, B. W. Briggs, Salt Lake City.

Tintic.—Projected, Provo City to Tintic, 40 miles. President, Geo. A. Rice; Chief Engineer, Geo. Goss; both of Salt Lake City.

Union Pacific.—Partly graded, Orton to Pioche, 137 miles; Chester to Manti, 15 miles.

Utah Central.—Under construction, end of track east, 25 miles.

Total.—Under contract or construction, 260 miles. Projected, 40 miles.

NEVADA.

(*See Union Pacific in Utah.*)

Total.—Under contract or construction, 67 miles.

IDAHO.

Northern Pacific.—Under construction, end of track to Lewiston, 78 miles. Surveyed, Lewiston to Asolin and Tammany Co.'s mines, 13 miles.

Total.—Under contract or construction, 78 miles. Surveyed or under survey, 13 miles.

CANADA.

ONTARIO AND EASTERN PROVINCES.

Annapolis & Atlantic.—Projected, Annapolis to Liverpool, N. S., with branch to Caledonia, N. S., 130 miles. President, Robert B. Hervey, Brockville, Ont.

Baie des Chaleurs.—Partly graded, Cascapedia to Paspebiac, P. Q., 40 miles.

Brockville, Westport & Sault Ste. Marie.—Projected, Westport, Ont., to Palmer Rapids, Ont., 80 miles.

Cobourg, Northumberland & Pacific.—Surveyed, Cobourg, Ont., to Central Ontario Junction, 40 miles. President, Robert Mulholland; Chief Engineer, H. K. Weekstud; both of Cobourg, Ont.

Grand Trunk.—Under construction, Blackwell toward Sarnia, 6 miles; Waterloo to Elmira, 10 miles. Surveyed, Edmundston toward Berrys Mills, 25 miles.

Great Eastern.—Projected, Nicolet to Levis, P. Q., 63 miles.

Irondale, Bancroft & Ottawa.—Projected, Bancroft to Irondale, Ont., 40 miles. President, Henry S. Howland; Vice-President, Chas J. Pusey; both of Irondale, Ont.

Lower Laurentian.—Under construction, end of track to Riviere à Perre, P. Q., 40 miles. Charles A. Scott, Quebec, P. Q.

Montreal & Ottawa.—Partly surveyed, Rigaud to Ottawa, Ont., 69.5 miles. Chief Engineer, J. M. Shanley, Hudson, Ont.

New Brunswick & Prince Edward Island.—Surveyed, Sackville to Wood Point, N. B., 5 miles.

Nova Scotia Central.—Projected, Middletown to Margarettstown, N. S., 8.5 miles.

Ottawa & Gatineau Valley.—Under construction, 10-mile post north, 40 miles. Chief Engineer, W. D. Harris, 14 Metcalf St., Ottawa, Ont.

Ottawa, Arnprior & Perry Sound.—Projected, Ottawa to Arnprior, 40 miles.

Quebec Central.—Under survey, Tring Station to Lake Megantic, Ont., 40 miles. Chief Engineer, E. Berryman, Seabrook, Ont.

Salisbury & Harvey.—Projected, Harvey, N. S., to Alma, N. S., 12 miles.

Stewiacke Valley & Lansdown.—Located, Brookfield, N. S., to Lansdown, N. S., 37 miles. Chief Engineer, L. H. Buck, Upper Stewiacke, N. S.

Tobique Valley.—Located, end track to Plaster Rock, 22.7 miles. Chief Engineer, C. L. B. Miles, Upper Andover, N. B.

Toronto Belt Line.—Located, belt line at Toronto, Ont., 8.5 miles. President, E. D. Edgar. Chief Engineer, H. Carey; both of Toronto, Ont.

Toronto, Hamilton & Buffalo.—Surveyed, Toronto, Ont., to Welland Junction, Ont., 77.5 miles. President, Alonzo Stephens, 164 Dearborn St., Chicago, Ill. Chief Engineer, E. B. Wingate, Hamilton, Ont.

Total.—Under contract or construction, 136 miles. Surveyed or under survey, 315 miles. Projected, 373.5 miles.

MANITOBA.

Calgary & Edmonton.—Under contract, end of track to Edmonton, 240 miles. Chief Engineer, Alex. Stewart, Calgary.

Canadian Pacific.—Under contract, Genboro to Souris, 50 miles.

Ontario & Rainy River.—Under contract, Port Arthur, Duluth & Western Ry. toward Lake of the Woods, 70 miles.

Port Arthur, Duluth & Western.—Under contract, end of track to International line, 47 miles.

Total.—Under contract or construction, 307 miles.

BRITISH COLUMBIA.

Canadian Pacific.—Track laid, Frazer River to International line, 10 miles. Partly graded, Sicamous to Okanogan, 51 miles. Surveyed, Ravelstoke to International line, 150 miles.

Total.—Under contract or construction, 61 miles. Surveyed or under survey, 150 miles.

THE AVERAGE ANNUAL RAINFALL IN THE UNITED STATES is placed at 29.6 ins., by Census Bulletin No. 32, with variations varying from 0 to 125 ins. Abou three-fourths of the whole population occupy the region in which the rainfall is from 30 to 50 ins., and the greatest density is in the area showing 40 to 50 ins., the average being 59 inhabitants to the square mile. In the eastern district of the Great Plains, stretching from Texas to Dakota, the rainfall ranges from 20 to 30 ins., and in the last 20 years the population has increased from 1.6 to 8.1 per square mile.

THE GREATEST DENSITY OF POPULATION, with reference to mean annual temperature, lies within the region where this mean ranges between 50° and 55°. The mean annual temperature of the United States is 53°. The density of population rapidly diminishes with the increase and decrease of temperature.

THE PROGRESS OF CANADA since 1871 is concisely set forth by the New York *Times* in the following little table:

	Popula'n, millions.	Tonnage built.	Millions of dollars. Rev.	Dapt.	Expts.	Impts.
1871.....	3.4	106,101	19.3	77.7	96.0	74.1
1881.....	4.3	79,364	29.6	155.3	105.3	98.2
1888.....	5.0	22,698	35.9	234.5	110.8	90.2

The same causes which have injuriously affected American ship building have affected Canadian, but more decidedly.

THE WORLD'S FAIR MANAGERS have abandoned the lake front, with the proposed buildings on that front, and will concentrate the exhibition at Jackson Park. The estimates show a saving of $1,000,000 in construction and operating expenses by this rearrangement, and a release from the difficulties of adjusting the railroad and other interests now on the lake front.

A NEW 8-IN. PIPE LINE is now in operation carrying crude petroleum from Morgantown, W. Va., to the Atlantic Refinery, at Point Breeze, Philadelphia. The line is said to have a capacity of 15,000 barrels per day, and exceeds by so much the 10,000-barrel pipe line reaching the same point from the Pennsylvania oil fields. It is controlled by the Standard Oil Co., which intends to increase its fleet of tank ships sailing from Philadelphia. In an air-line the distance from Morgantown to Philadelphia is about 230 miles.

THE BOSTON, NEW YORK & CAPE COD CANAL Co. is seeking incorporation in Massachusetts. The purpose of the company is stated to be the purchase of the old Cape Cod Canal Co.'s rights and the completion of the canal within four years. The estimated cost of the work proposed is $6,000,000.

TAR FUEL, says *The Railway News*, is being successfully tested on the Great Eastern Railway, in England, as a substitute for coal in raising steam. Mr. HOLDEN, locomotive superintendent of that line, has patented an injector for use in this connection, and has placed the new fuel on a dozen locomotives as an auxiliary to coal. This is tar, with some green oil from tar works added. The cost is 1½ cts. per gallon. Each engine uses about 12 lbs. of coal and one gallon, or 11 lbs., of the fluid fuel per train mile, as against 34 lbs. of coal. The relative cost is rather less than coal; but the chief value of the new fuel is on grades, where steam can be raised instantly by turning a tap.

ELECTRICAL TRANSMISSION OF POWER is to be tried at the Oerlikon Engineering Works, near Zurich, Switzerland. Experiments have demonstrated the possibility of transmitting a current, from Lauffen on the Neckar to Frankfort on the Main, a distance of 92 miles and at an electromotive force of 20,000 volts. Satisfactory tests were made, with pressures ranging from 15,000 to 33,000 volts. The Swiss firm has control of a waterfall in Hochfelden, with power sufficient to operate turbines capable of driving two dynamos of 200 to 300 HP. each. The current thus generated will be transformed to an electromotive force of 20,000 volts, and this will be transmitted, by four over-head conductors 0.157 in. diameter, 12½ miles to the works. It is expected that the new power will be in operation in April next.

TWO OF THE WHALEBACK FREIGHT BOATS, invented by Capt. ALEXANDER MCDOUGALL, of West Superior, Wis., are to be sent to the Pacific Coast, says the Cleveland *Herald*. They will be sent to salt water in the spring, and one will go direct to Puget Sound, and the other, it is now proposed, will be sent first to England and then to the Pacific.

THE CHESAPEAKE & OHIO CANAL, according to Judge ALVEY'S recent decision, is practically handed over to the bondholders of 1844, who would be entitled to possession with the right to repair and operate it.

CABLE RECORDS FOR STREET RAILWAYS are reported as follows for cables made by John A. Roebling Sons & Co.: One taken up on Sutter St., San Francisco, ran 16 months and 20 days, making a total distance of 70,267 miles. A cable recently taken from Temple St., Los Angeles, had been running 845 days, and a distance of 121,680 miles. This last is given as the best cable record known. A new 1¼-in. cable, 26,200 ft. long, has just been put down by the same firm on the Jackson St. line in San Francisco.

A NOVEL METHOD OF RUNNING ELECTRIC CARS ON STEEP GRADES has been proposed by Mr. J. P. F. KUHLMANN, Engineer of the Rainier Avenue Electric Co., of Seattle. At one point on this line is a grade of 16%, about 800 ft. long. The electric motors used on the cars are not of sufficient power to surmount the hill, and an auxiliary motive power of some kind is necessary. An independent cable plant would be much too expensive. Mr. KUHLMANN proposes to lay a small conduit, 2 ft. square, between the two tracks and run a small counterbalance car on suitable rails within it. Attached to this car will be two steel ropes, about 800 ft. long, and provided with grips at the free end, to which the drawbar of the car may be attached. Tail ropes will run from the grips around sheaves at the bottom of the incline and then up to the counterbalance car. When a car reaches the top of the incline, the drawbar will be attached to the grip, and the down-hill trip begun. The weight of the car, aided by the motors, will pull the counterbalance weight to the top of the hill. When a car is about to run up-hill, the grip and drawbar are coupled and the counterbalance car is started down the incline by the tail rope. Only one car is on the incline at once, otherwise a larger conduit and 2 weights would be necessary. The local newspaper from which this account is taken states that the construction of the road will begin as soon as the necessary castings can be made.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Evansville & Terre Haute.—About $200,000 will be expended in rebuilding bridges and trestles and repairing the roadbed of this line.

New York Central & Hudson River.—It is stated that work will begin on the Mohawk & St. Lawrence R. R. in about two weeks.

Lower Laurentian.—C. A. Scott, Quebec, P. Q., writes as follows:

About 33 miles are graded, and 15½ miles of track are laid on the extension of this road from St. Tite to Rivierre a Pierre, P. Q. The work is principally earthwork averaging about 20,000 cu. yds. per mile, with some rock-work averaging about 6,000 cu. yds. per mile; maximum curve 8°, and maximum grade 105 ft. per mile. There will be a bridge across the Batiscan River, consisting of two 104½ ft. spans and one 100½ ft. span. The right of way has been all secured, and the location is completed.

Projects and Surveys.

New York, Schenectady & Ogdensburg.—A press dispatch says:

The preliminary work on the New York, Schenectady & Ogdensburg R. R. is being pushed forward rapidly. Surveyors are now at work from Rosendale to Jersey City, the balance of the route having been surveyed. The road will run along the base of the Catskills, about 15 miles west of the West Shore. It passes through a rich agricultural and quarry region, and touches many popular summer resorts. From Ogdensburg connections will be formed with the Canadian Pacific.

Pittsburg & Moon Run.—M. F. Sanford, of Chartiers, Pa., writes as follows:

The surveys are completed for this railway and contracts will be let soon. The road is projected to run from Groveton, Pa., on the Pittsburg & Lake Erie R. R., to Bennington, Pa., a distance of 6 miles. The work will be generally light and the grades and curves easy. Nearly all of the right of way has been secured. It is expected to have the line completed by July 1. President, Aaron Wilcox; Chief Engineer, W. L. Davison, Pittsburg, Pa.

Peterborough, Sudbury & Sault Ste. Marie.—E. H. D. Hall, of Peterborough, Ont., writes us that this road is projected to run from Peterborough, Ont., via Huntsville, to Sudbury, Ont., 236 miles, and thence to Sault Ste. Marie, Ont., 179 miles further. The line will pass through the center of the nickel mining district. Surveys will probably commence during the summer. John Burnham, Q. C., is President.

Seneca County.—Chartered in New York to build a railway from near Geneva, N. Y., to the village of Seneca Falls, a distance of 10 miles.

Little Falls & Dolgeville.—This company has been chartered to build the railway mentioned last week as to be constructed from Little Falls to Dolgeville, N. Y., 10 miles. Warren D. Loss, 18 Broadway, New York City.

Lake Hopatcong.—At a recent meeting of the citizens at Morristown, N. J., to consider the construction of this road a committee was appointed to solicit subscriptions and push the preliminary work. A profile and map of the route was submitted by D. M Culver, of New York City. According to this the line extends from the New York & Greenwood Lake R. R. to Caldwell, N. J., thence northerly to Whippany, Troy Hills and Rockaway, from which place it will run over the New Jersey Central line to Hopatcong. From Troy Hills a spur will extend to Morristown and Boonton. The amount of capital required is $360,000, of which $190,000 has already been subscribed.

SOUTHERN.—Existing Roads.

Atlantic & Danville.—The contract will soon be let for the first 50 mile section of the Danville & East Tennessee R. R., from Danville, Va., west. T. W. M. Draper, Chief Engineer, Norfolk, Va.

Abbeville & Way Cross.—Work will begin March 1 on a 23-mile extension of this road from Bower's Mills.

Florilla & Indian Springs.—This road, running from Florilla to Indian Springs, Ga., is now practically completed.

East Tennessee, Virginia & Georgia.—It is reported that this company will shortly call for bids to double track its line from Knoxville to Morristown, from Knoxville to Coal Creek, and from Chattanooga to Ooltewah.

Ohio River.—This company has decided to build a line from Guyandotte to Kenova, W. Va., 11 miles. The Guyandotte River will be bridged and an independent line built into Huntington, where a large depot will be constructed.

Paducah, Tennessee & Alabama.—The contracts will be let within a few months to build the extension from Paris, Tenn., south to Hollow Rock, about 20 miles. Very few men are now employed upon the construction work. About 200 are laying the last few miles of track from the end of track south of the Kentucky State line to Paris. The maximum grade on this section is 52.8 ft., and the maximum curvature is 6°. The bridge at Paris is very nearly completed It is 1,343 ft. long. The average height s 60 ft., the greatest height being 65 ft.

Nashville, Chattanooga & St. Louis.—President Thomas, of this road, is quoted as saying that within the next 18 months $500,000 will be spent in improving the Western & Atlantic R. R. He further says: "There are forty-five wooden bridges between Chattanooga and Atlanta, and every one of which is to be rebuilt with iron. The road is now being laid with 70-lb. steel rails, and new stations are to be erected along the line. Surveyors are now making a profile for a map of the road for the purpose of ascertaining the grades. When all these things are completed we shall put on heavy engines like those on the Nashville, Chattanooga & St. Louis R. R."

Macon & Atlantic.—Tracklaying is progressing on the Macon & Atlantic R. R. east of Bruton at the rate of 1¼ miles per day. There are 200 men in the tracklaying gang and 600 teams and 1,500 men on the grading. The contractors are now grading between Stillmore and the Ogeechee River. The grading is comparatively easy, and if the weather continues good the work will progress very rapidly. The rails are of 70 lbs. steel, bolted together with angle bars or fish plates 52 ins. in length. When finished the road will cost, exclusive of the rolling stock, about $12,000 per mile.

South Bound.—The grading on the section on the south side of the Savannah River, a distance of 39 miles, is nearly finished, and it is expected that the rails will be laid, and cars will be running to the bridge by April 15. The work on the iron bridge across the river has been greatly retarded by the continued freshets. In South Carolina, the work of construction is progressing rapidly along the entire line from the Savannah River to Columbia.

West Virginia & Pittsburg.—The contract has been let for building the 37-mile section from Shanersville, W. Va., to the Williams River. Shanersville is a small village a short distance from Sutton, the present terminus of the road. From there the line will run along Laurel Creek to Williams River, where the timber lands of the company are located. The line between Weston and Sutton is completed, and the Buckhannon branch has been finished to Newton, about 25 miles. The continuation of this branch to Florence, as well as the Williams River extension, will, it is expected, be finished and ready for operation before the close of the year.

Way Cross Air Line.—Thirty miles of this line between Way Cross and Douglas, Ga., have been completed.

Decatur Belt.—The Decatur Land & Improvement Co. of Decatur, Ala., proposes to complete a belt line at New Decatur by extending the present system of manufacturers' side track. The land company has donated a large tract of ground in the city to a company which has been organized to build a union station in the town. When the belt line company is organized it is intended that it shall control the station and all the terminal facilities, as well as the belt line.

Projects and Surveys.

Oxford & Coast Line.—Application has been made to the North Carolina Legislature for a charter to build a

railway from Oxford to either Springhope or Nashville, N. C. H. C. Henderson, Oxford, N. C.

Fincastle & Troutville.—It is reported that work will begin on this Virginia railway by April 1. It will run from Fincastle to Troutville, Va., 6¼ miles. E. B. Simmons, Fincastle, Va., President.

Glasgow Belt.—The surveys have been commenced for a railway connecting Glasgow, Va., with the mines at Arnold's Valley.

Augusta Belt.—A company has been organized with E. J. O'Connor, Vice-President, to build a belt railway 15 miles long, at Augusta, Ga.

Alabama.—A press dispatch from Montgomery, Ala., says:

The House to-day passed the Senate bill disposing of the 2s and 3s fund in the State Treasury. The bill appoints a commission composed of Ex-State Senator R. T. Simpson, of Florence; Ex-Governor Thomas Seay and Senator John T. Milner to have a survey made for a line of road from the Tennessee River through west Alabama to Mobile. Nine thousand dollars of the fund is devoted to making this survey, and the object is to lay before capitalists the great mineral resources of north Alabama, and to induce them to undertake the construction of this road.

Macon Terminal.—It is proposed to charter a company by this name to build a belt line transfer railway at Macon, Ga. The road will be three miles long and will cost about $45,000.

Pittsburg & Southern.—Chartered in West Virginia, to build a line of railway from Blacksville, W. Va., to Clarksburg, W. Va., about 67 miles. Among the incorporators are: A. N. Pritchard, Mannington, W. Va., and T. M. Jackson, Clarksburg, W. Va.

Tombigbee.—The surveys have been completed and the estimates made for the construction of this road, and it is hoped to begin construction at an early date. The road is to run from Columbus, Miss., to Houlton, Ala., 132 miles. C. E. Rodenburg, Columbus, Miss., General Manager.

NORTHWEST.—Existing Roads.

Escanaba, Iron Mt. & Western.—This road, it is stated, has been sold to parties supposed to represent the Vanderbilts, and the Chicago & Northwestern R. R. Co. It is now completed from Escanaba to Iron Mountain, Mich., a distance of 53 miles, and considerable of the grading has been done from Iron Mountain to Florence, Wis., and some work has been done on the projected extension from Florence to Crystal Falls. At the Escanaba terminus of the road, extensive ore docks are being built, having a capacity for 40,000 tons of ore, and containing 232 pockets or ore bins from which to load ore into vessels. These docks are understood to be a part of the railroad property and are included in the sale. The building of the road and docks has entailed an expense of over $1,000,000. They were designed by the Schlesinger syndicate, operating the Chapin and other mines in Northern Michigan, for use in transporting the product of the mines to the lake.

Mason City & Fort Dodge.—At a recent meeting of the stockholders the articles of incorporation of this road were amended to permit of the road being extended from Lehigh to Council Bluffs, Ia.

Projects and Surveys.

La Salle & Bureau County Belt Line.—Surveys are now being made by Civil Engineer Isham Randolph, of Chicago, for an 8 mile railway connecting the Chicago & Northwestern, the Chicago, Burlington & Quincy and the Chicago, Rock Island & Pacific railways.

Rainy Lake, Crookston & Pacific.—Chartered in Minnesota to build a line of railway from Rainy Lake to the Pacific coast.

Chicago, Forest & Eastern.—Chartered in Illinois to build a railway from Chicago, Ill., to some point in Indiana. Among the incorporators are: Wm. A. Cottrell, A. C. Hawley and Chas. G. Wetton, all of Chicago.

Huron, Chamberlain & Black Hills.—Ed. F. Harmston, of White Rocks, Utah, Chief Engineer, writes as follows:

The surveys have been completed for this railway, which is projected to run from Huron, via Alpena, Wessington Springs, Corn Lake, and Packwana to Chamberlain, S. Dak. 78 miles. The route is through a undulating prairie country for a greater part of the way, and construction will be very light, except for about 15 miles through the Wessington Hills and 7 miles from the Missouri River to the prairie. The maximum grade is 0.66 and the maximum curve 3°. About 26 miles of the right of way has been secured and $60,000 in local aid obtained. David H. Henry, Chamberlain, S. Dak., President, and Louis N. Loomis, Alpena, S. Dak., Secretary.

SOUTHWEST.—Existing Roads.

Kansas City, Watkins & Gulf.—This company has obtained the charter of the Rapides Bridge Co., and will build a combined railway and wagon bridge over the Red River at Alexandria. Work, it is stated, will be rapidly pushed on the extension from Alexandria south, and it is hoped to have the entire line in operation this season.

Projects and Surveys.

Beeville, Lagarto & Rio Grande.—H. B. Newberry, of Lagarto, Tex., President, writes as follows:

This road is projected to run from Beeville, via Lagarto, to San Diego, Tex., 160 miles. Surveys will begin as soon as sufficient stock is subscribed. The work will be generally light and the grades and curves light. The right of way will be given and about $45,000 local aid has already been secured.

Clarendon, Oklahoma & St. Louis.—A railway company by this name has been organized at Clarendon, Tex. The capital stock is $1,000,000. The charter has been applied for, and the road is to run from Clarendon through Donley, Collingsworth, and Greer counties, in Texas; thence across the state line, through the Indian Territory and Oklahoma, to a direct connection with St. Louis.

Parsons Belt Line.—At a recent meeting of the directors of this company the following officers were elected: President, C. H. Kimball, of Parsons, Kan.; Vice President, Wm. Martindale, Emporia, Kan.; Secretary and Treasurer, Lee Clark, Parsons.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Northern.—The grading is practically completed on the Seattle & Montana R.R.; and as soon as the roadbed is dry enough the track will be laid.—The grading has been completed on the Pacific extension to the Rocky Mts.; and from this point to the Kootinai River construction is being pushed. The line through Washington has not been located yet, but it is expected that a route will be decided upon in a few months. It is expected to have the entire line completed to the coast by Jan. 1, 1893.

Sonora, Sinaloa & Chihuahua.—It is stated that John W. Young has received control of the concession for this Mexican road and will complete it. A new company has been organized, and it is stated that work will be commenced soon.

Projects and Surveys.

Silverton & Oregon City.—A movement is on foot to build a line of railway from Silverton to Oregon City, Ore.

CITY TRANSIT.

Electric Railways.—New lines are reported as probable in the following places: Rutherfordton, N. C.; Newark, N. J., address the Rapid Transit Co.; Tampa, Fla., address the South Florida Electric Light Co.; Hamilton, O., address the Hamilton Street Ry.; Denver, Colo., address the Denver-Arapahoe Land Co.; Ballard, Wash., address City Clerk Hadfield; Ashland, Mo.; Buena Vista, Colo.; Bozeman, Minn.; York, Pa., address R. V. Thomas; Charleston, S. C., address K. T. Tupper; Anoka, Minn.; Elgin, Ill., address A. B. Church; Newton, Mass., address the Newton Street Ry.; Little Rock, Ark., address the Capital City Street Ry.

Portland, Me.—Manager Newman, of the Portland Horse R. R., has applied for permission to operate a portion of his lines by electricity. His intention is to run electric cars between this city and Deering, where the necessary permission has already been obtained.

Gloucester, Mass.—The Gloucester Street Railway Co. is reported to have obtained control of the United Electric Traction Co.'s property in this city for the purpose of operating its lines by the trolley system.

Worcester, Mass.—The Barrett storage battery, which has been operated with marked success on the Beverly & Danvers Street Ry., is to be tested in this city.

Brooklyn, N. Y.—The State Railroad Commission has granted the application of the Jamacia & Brooklyn R. R. for their approval of a change of its motive power from horses to electricity. The Brooklyn City Railway Co. has applied to Commissioner Adams for a permit to erect trolley poles on a number of streets. The entire route is 6 miles long, 2 miles being in the city.

Pittsburg, Pa.—The new power house of the Duquesne Traction Co. was burnt last week and nearly all the engines and dynamos were ruined. The loss is estimated at $75,000 or $100,000.

Savannah, Ga.—The Electric Railway Co., J. S. Collins, President, has contracted with the Edison General Co. for a 3-mile line, to be in operation by June 1.

Michigan City, Ind.—The Citizens' Street Ry. is reported as sold to a Chicago sydicate, represented by E. D. Cummings, which will extend the lines and introduce electricity.

Racine, Wis.—The People's Street Ry. Co. has received a franchise to build and operate an electric railway in this city.

St. Louis, Mo.—The St. Louis & Suburban Ry. will, it is said, substitute electricity for steam and cable propulsion on 16 miles of its lines.

Vernon, Tex.—A franchise has been granted to R. B. Gant for constructing lines on several streets.

San Francisco, Cal.—The House has passed a bill permitting electric railways in this city.

Port Arthur, Ont.—W. P. Cooke, Chairman Railway Commission, will receive bids until April 1 for supplying 273 tons of 40-lb. rails, with fish plates, bolts, frogs and switches, for 4½ miles of electric railway.

Horse Railways.—New lines are reported as probable in the following places: Carrollton, Ga.; Danville, Va., address T. B. Fitzgerald; Egg Harbor, N. J., address the Egg Harbor Land Co.; Worcester, Mass., address F. Barnard; Buffalo, N. Y., address W. B. Reading.

Buffalo, N. Y.—F. G. and G. R. Sikes have been engaged to make surveys for a street railway to West Seneca. The cost of the line is estimated at $80,000.

Dummy Railways.—*Greenville, S. C.*—The Queen City Investment Co. wants bids for furnishing rolling stock for a standard gage line.

Dummy Railway.—*Santa Clara, Cal.*—R. H. Quincy has petitioned the Santa Clara Supervisors for a franchise to construct a dummy road at an estimated expense of $150,000.

Elevated Railways.—*Brooklyn, N. Y.*—The aldermen have granted the Seaside & Brooklyn Bridge Elevated R. R. a franchise for building an extension of the present Union Elevated R. R.

New Companies.—American Hydraulic Sliding Railway Co., Chicago, Ill.; capital stock, $100,000; incorporators, J. Juvenet, J. Rigoulot, E. T. Cragin. Lincoln, Ill., Electric Street Railway Co.; capital stock, $65,000; incorporators, E. D. Blinn, A. Quisenberry, J. F. Mundy.

HIGHWAYS.

New Hampshire.—Mr. W. H. Manahan, of Hillsborough, has been appointed by the County Court to lay out a new road from Manchester to Goffstown.

New York.—Senator McNaughton has made a suggestion to the Highway Commissioners of Monroe Co. that they meet in convention to discuss the highway improvement question, and report the recommendations which they may agree upon. The second annual meeting of the New York State Improvement Association was held at Syracuse, N. Y., Feb. 24.

Georgia.—The grand jury has recommended the construction of a new road from Savannah to the Isle of Hope. The County Commissioners have been proposing the construction of a shell road, and it probably will be built.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Bay City, Mich.*—A special meeting of the Board of Supervisors has been called for March 2, to consider the matter of submitting, at the spring election, the question of bonding the bridge district for $30,000 to assist in building bridges, the enabling act having passed the legislature.

Bryson City, N. C.—Bids are asked for the construction of an iron bridge. N. Newby, Bryson City.

Knoxville, Tenn.—The Cherokee Land Co. will, it is stated, contract for the construction of a bridge across the Tennessee River, to cost $500,000.

Milwaukee, Wis.—New plans have been prepared for the proposed viaduct across the Menominee Valley, between Sixteenth St. and Eleventh Ave. The structure will be of stone and iron, 4,305 ft. long, with a 40-ft. roadway and two 10-ft. sidewalks. Its height above the valley will be 30 ft. There will be a draw span across the Menominee River. Estimated cost, $485,000.

WATER-WORKS.

NEW ENGLAND.

Springvale, Me.—About ½ miles of mains will be laid during the coming season.

Keene, N. H.—P. F. Babbidge, Superintendent, informs us that about 10 miles of cement-lined pipe will be taken up and cast-iron pipe put down in its place.

Bridgewater & East Bridgewater, Mass.—The following is from H. H. Thorndike, Superintendent:

Several extensions [probably to the mains] are to be made. The town of Bridgewater has just voted to buy the works, and we are now awaiting the action of the town of East Bridgewater. The works were built by B. C. Mudge & Co., and are now in the hands of the Massachusetts Loan & Trust Co.

Holbrook & Randolph, Mass.—E. J. Chadbourne, Superintendent, has sent the following:

Bids are invited for a 1,500,000-gall. pump, working against a head of 250 lbs. with 60 lbs. of steam. Water is delivered through 15,000 ft. of 14 and 3,000 ft. of 12-in. pipe to the Randolph, and through 15,000 ft. of pipe to the Holbrook stand-pipe. We hope to place our order early in March.

East Greenwich, R. I.—J. L. Langdon, Superintendent, informs us that the company thinks of extending its mains to Apponaug, a village of 600 inhabitants.

Bethel, Conn.—E. C. Oakley, Superintendent, informs us that bids for the dam and filter bed have been postponed until March 2, and W. B. Rider, Engineer, South Norwalk, writes that the dam may be raised 5 ft.

MIDDLE.

Millerton, N. Y.—Bids for works were received by the village Feb. 27. F. H. Thompson and J. W. Pulver are two of the four commissioners.

Allegheny, Pa.—J. G. Wyman, Mayor, informs us that the people have voted down the proposition for an increased supply.

Kennett Square, Pa.—E. P. Mercer informs us that changes are to be made in the pumping machinery.

Minersville, Pa.—C. R. Kear, Secretary, has sent the following:

Four miles of 8-in. mains are being replaced by 14-in., and two new reservoirs are being built, one on Wheeler Creek and one on Dyer's Run. The company proposes to supply Deer Park, Yorkville and the higher points in Pottsville through an 8-in. main four miles long; also the Lytle Coal Co. and the town of Primrose, one mile distant, with a 6-in. main.

SOUTHERN.

Carnegie City, Va.—It is reported as probable that the Pittsburg Development Co. will build works.

Danville, Va.—The reservoir will probably be enlarged.

New Castle, Va.—Reports state that the New Castle Water Co. will build works at a cost of $10,000.

Radford, Va.—A 2,000,000-gall. duplex pump is being put in by the Laidlaw & Dunn Co., Cincinnati, O.

Huntington, W. Va.—It is reported that new pumps will be added.

Keyser, W. Va.—A bill authorizing the issuance by the city of $20,000 water bonds has been introduced in the legislature.

Atlanta, Ga.—About $3,000 worth of pipe will be laid at once.

Dothen, Ga.—Bonds for water-works have been authorized.

Tredegar (Jacksonville P. O.), Ga.—A bill authorizing $50,000 of bonds for water-works and other purposes has passed the legislature.

Fayetteville, N. C.—It is proposed to grant a franchise for new works. Those now in use were built in 1823.

Raleigh, N. C.—The purchase of the company's works is under consideration by the city.

Fort Valley, Ga.—The following is from J. D. Marshall:

The Water Commissioners have elected H. C. Harris as President, and require the services of an engineer to make plans and specifications.

Opelika, Ala.—The American Pipe Co., of Philadelphia, it is reported, will make a proposition to put in works.

Johnson City, Tenn.—A press dispatch states that the parties putting in the works have not given bonds for its performance, and that the city may yet conclude to build and own works, issuing $50,000 of bonds for the purpose.

North Knoxville, Tenn.—The Knoxville *Journal* states that the council has passed an ordinance in favor of the Knoxville Water-Works Co. Both this company and the Capital Springs Water Co. were applicants for a franchise.

Mayfield, Ky.—The following is from B. A. Neale:

Owing to the failure of the contractors, water-works have not been completed. We wish some company to build and own the works. The city wishes 5¾ miles of pipe and 54 hydrants at a yearly rental of $3,000 for 25 years. The population is 4,000. The assessed valuation of the city is $1,500,000, including banks, and the city does not owe a dollar.

NORTH CENTRAL.

Petoskey, Mich.—G. S. Richmond, Superintendent, informs us that a new pump, reservoir and an extension to the mains are contemplated.

Saginaw, Mich.—J. F. Maher, Secretary, informs us that East Saginaw has been consolidated with Saginaw, and that the works of both places are now operated together.

Galesburg, Ill.—J. C. Stevens, City Clerk, informs us that the city is just completing works of their own, and W. C. Hawley, Superintendent of Construction, states that the supply is from 40 4-in. tubular wells, 65 to 85 ft. deep, with strainers 20 ft. long. There will be about 13½ miles of mains. The works, it is expected, will be in operation about May 1.

Jacksonville, Ill.—Another artesian well will be sunk for the water-works this year.

Wheaton, Ill.—The following is from H. N. Fuller:

The village proposes to build works costing $20,000, pumping from a deep well to a stand-pipe. Definite arrangements have not been made. Population, 2,000.

NORTHWESTERN.

Harlan, Ia.—The following is from J. S. Mill:

The town will issue bonds for works to cost from $8,000 to $10,000. The supply will be pumped from wells to a stand-pipe. No engineer has yet been engaged. Population, 2,000.

Wall Lake, Ia.—It is reported that a vote on works will soon be taken. C. C. Watson recently informed us that pumping will be used, and the works are estimated to cost $2,500.

West Liberty, Ia.—C. E. Chesebrough, Superintendent, informs us that extensions are contemplated.

Alexandria, Minn.—R. Dimond, Superintendent, informs us that they propose to lay a suction pipe to the lake.

Duluth, Minn.—It is reported that the company will lay a new intake, and has already purchased the pipe.

Ely, Minn.—The following is from D. H. Martin, Engineer:

The town has small fire protection works, but the water pumped is not potable. There is but one good well in the town. Citizens are talking of putting in works for domestic supply, and probably something will be done before the end of the year.

New Ulm, Minn.—L. Schilling, Secretary, informs us that bids are wanted for 11,000 ft. of pipe and 15 hydrants.

Great Bend, Kan.—J. A. Pritchard, Superintendent, informs us that the company is being reorganized, and that extensive improvements are contemplated.

Kingman, Kan.—R. A. Munson, Superintendent, informs us that the Kingman Water & Light Co. is being organized and has a franchise to operate the works of the former company; paid-up capital stock, $150,000.

Oakes, N. Dak.—J. E. Sperling informs us that the construction of works will be started in the spring.

Sundance, Wyo.—T. M. Pettigrew, Secretary, informs us that the company expects to increase the supply, build a new reservoir and lay 5 miles of mains this year.

Great Falls, Mont.—E. W. King, Superintendent, informs us that the company proposes to lay 3 or 4 miles of 6-in. mains this year.

SOUTHWESTERN.

Denison, Tex.—It is reported that the company will put in new pumps and extend its mains 2 miles to North and West Denison.

Cleburne, Tex.—B. F. Frymire, Mayor, informs us that the city water-works have been bought by S. E. Moss, who will improve them and will put down artesian wells.

Sulphur Springs.—A. P. Landers will receive bids for works until April 1.

Tyler, Tex.—The company is introducing a new supply and building a large storage reservoir 4 miles west of the city. It is stated that the reservoir will cover 100 acres.

PACIFIC.

Ballard, Wash.—The Ballard City Water-Works Co. has applied for a franchise. It seems probable that it will not receive one, since the present works, it is stated, are sufficient and municipal ownership is favored.

Corvallis, Ore.—Water-works bonds to the amount of $50,000 have been authorized by a new city charter. The Corvallis Water Co. built works in 1887.

La Grande, Ore.—J. K. Romig, who proposes to build works, has sent the following:

A franchise for works has been secured and a company will be organized. The town will take 40 hydrants and the Union Pacific Ry. Co. will be supplied. The supply will be pumped from springs and wells to a reservoir; estimated cost, $60,000. A. L. Adams is Engineer in charge of surveys. It is expected that construction will begin March 1, but capital has not been secured. Population, 3,000.

Mount Tabor, Ore.—The Mount Tabor Villa Water Co. has been incorporated by George Richwin, O. S. Murry and J. S. Hopper; capital stock, $5,000.

Portland, Ore.—The following is from I. W. Smith, superintendent:

The legislature has amended the city charter, and authorized the issuance of $2,500,000 of bonds. A new supply will be received from Bull Run, a stream heading within 10 miles of Mt. Hood. A wrought-iron conduit 30 miles long will be laid. This will change at the crossing of the Willamette River, which is 2,000 ft. wide, to two cast-iron pipes. The conduit will cross Bull Run three times and Sandy River once by means of bridges. The expenditure of about $500,000 is proposed for cast-iron pipes within the city and for reservoirs. The new conduit will have a daily capacity of from 20,000,000 to 25,000,000 galls. The water committee will meet March 3 to take steps to carry on the improvements.

Ontario, Cal.—F. E. Trask, Engineer, informs us that about 2,000 ft. of 8 and 6-in. pipe will be laid in the town system this year.

San Jose, Cal.—The Glen Weber Water Co. has applied for a franchise. Its proposed water supply is from an impounding reservoir formed by a dam below the junction of the Las Animas, Packwood and Cayote streams. It is said that the company will build the works, then sell them to the city, taking payment in 6% bonds.

Tucson, Ariz.—The Tucson Water-Works Co. has been incorporated at Atchison, Kan.; capital, $20,000. Works were built here in 1881 by the Tucson Water Co.

Canada.

Annapolis, N. S.—William Hull, Mayor, informs us that the bids received recently have been rejected, and that an engineer will be employed to make plans and new bids asked.

ARTESIAN WELLS.

Waycross, Ga.—Contractor Wade has a well down 300 ft. Eight-inch casing will be used.

Broadhead, Wis.—A flowing well has been secured at a depth of 893½ ft.; Gray Bros., Milwaukee, were contractors.

Lemoore, Cal.—A flowing well has been secured at a depth of 90 ft.

IRRIGATION.

Lake Weir, Fla.—It is reported that irrigation is being quite generally adopted at Lake Weir and in the vicinity.

Kansas and Colorado.—The following incorporations are from the *National Corporation Reporter*. The figures indicate capital stock:

Royal Ditch Co., Royal School Home, Kan.; South Fork Irrigation & Improvement Co., St. Francis, Colo., $100,000; Topeka Water Electric Power & Irrigation Co., Topeka, Kan.; Continental Irrigating Co., Denver, $500,000; Taylor & Gill Ditch Co., La Porte, Col., $6,000; Rough & Ready Irrigating Ditch Co., Longmont, $9,540.

Colusa, Cal.—Bids are wanted for building a dead gate and conduit by the Central Irrigation District. The inlet and outlet chambers of conduit at its passage beneath Stony Creek, and the masonry of the head gate will be of brick furnished by the contractor. The creek crossing will be 650 ft. long, a semi-circular wooden flume covered with a plank platform.

SEWERAGE AND MUNICIPAL.

Sewers—***Springfield, Mass.***—Mr. Rudolph Hering is to make an examination of and report upon the sewerage system.

Quincy, Mass.—A sewerage system is projected. The work will be under the charge of the Commissioner of Public Works.

Albion, N. Y.—The village has a system of surface sewers. Surveys and plans for sewers have been made by D. Waldo, and have been approved by the State Board of Health. The matter is now before the taxpayers. G. L. Baker is village clerk.

Jamestown, N. Y.—It has been voted to build sewers and the matter is now under consideration by the Board of Public Works.

East Orange, Mass.—The investigating committee of the Town Improvement Society has reported that the present system of sewage disposal is a success, and can be extended for a much larger population.

Butler, Pa.—The Waring system of sewers has been adopted; about 20,000 ft. were laid last year, and work is now in progress. C. F. McQuiston is Borough Engineer.

Manchester, Va.—The Street Committee has been directed to ascertain the cost of a sewerage system.

Athens, Ga.—The city is building a system of sanitary sewers. J. W. Barnett is City Engineer.

Columbia, Ga.—The city has surface drainage, and will probably commence the construction of a system of sanitary sewers this year. B. H. Hudson is City Engineer.

Pittsburg, Tenn.—A system of sewers is projected. For particulars address M. B. Shea.

Ironwood, Mich.—If the legislature authorizes the issue of bonds for $20,000, it is proposed to spend this amount in sewer work next summer.

Traverse City, Mich.—It is expected to put in about 1½ miles of sewers this season.

Dixon, Ill.—About 3 blocks of sewers are to be laid during the spring.

La Vergne, Ill.—An effort is being made to have the town trustees amend the recently enacted sewer ordinance so that the proposed outlet sewers at Oak Park and Ridgeland Aves. shall be diverted and combined in one sewer along the right of way of Illinois R. R. to Mead Lake.

Janesville, Wis.—A system of sewers is to be established, and action will be taken shortly.

Waukesha, Wis.—The village has about completed the main sewers, and will put in the smaller ones this year.

Denver, Col.—The storm sewers are to be extended at a cost of $20,608; the North Denver sanitary sewer will cost $18,071.

Portland, Ore.—The six bids for a sewer in Joe Thomas Creek ranged from $32,007 to $62,210.

Corvallis, Ore.—Bonds for $30,000 are to be issued for sewers.

Seattle, Wash.—It is stated that Mr. Benezette Williams, of Chicago, Ill., is to make a report upon and prepare plans for a system of sewers.

Woodland, Cal.—Surveys and plans are to be made for a system of sewers to cost about $35,000. For particulars address the Board of Trustees.

San Luis Obispo, Cal.—It has been voted to issue bonds for $50,000 for sewers and other improvements.

Streets.—***Burlington, Vt.***—The report of Mr. Dow, City Engineer, shows that the city has 7.74 miles of paved and macadamized roads, 11.92 miles of graveled roads, 8.48 miles of flagged and curbed sidewalks.

New York, N. Y.—The expenditure of the $1,000,000 remaining from the $3,000,000 appropriated for street paving has been arranged as follows: Granite blocks on concrete, 101,400 sq. yds., $405,600; asphalt on present foundations, 39,800 sq. yds., $159,200; asphalt on concrete, 6,060 sq. yds., $28,482; asphalt on present stone block pavements, 74,480 sq. yds., $297,920; total, 221,740 sq. yds., $891,202.

Richmond, Va.—The Street Committee has applied for $750,000 for the present fiscal year.

Atlanta, Ga.—The Board of Aldermen has passed ordinances authorizing about $56,000 of paving.

Athens, Ga.—It is proposed to issue bonds for $250,000 for streets and sewers.

Montgomery, Ala.—An ordinance has been adopted authorizing the issue of bonds for $94,000, of which $50,000 will be for street paving.

Peoria, Ill.—An ordinance has been passed authorizing the paving of Moss Ave. with 1½ ins. of asphalt on a 6-in. foundation of concrete.

Street Sprinklers.—***Denver, Col.***—Proposals for furnishing sprinklers have been submitted by the W. J. Kinsey Co., Hoyt, Savage & Moffatt, J. A. Duganhart and Morcan & Nesmith (Colorado Iron Works), all of Denver; also by Steible, Kinsingert & Steible, of Cincinnati, O., and the Studebaker Mfg. Co., South Bend, Ind.

ELECTRICAL.

Electric Light.—New plants or extensions are reported as probable in the following cities: Wheaton, Ill.; Logan, O.; Dayton, Tex.; Trinidad, Colo., address, L. Horn; Nelsonville, O., address Post & Sleeper; Averill, Vt., address the Averill Lumber Co.; Stoughton, Wis.; Creal Springs, Ill.; Medway, Mass.; Monmouth, Ill.; Reynoldsville, Pa., address Bell, Lewis & Yates; Elyria, O.; Newberry, S. C.; Harlingen, N. Y.; Salem, Va., address the Hockman Land Co.; Chester, S. C.; Du Quoin, Ill.; Cleburne, Tex., address S. E. Moss, Morgan, Tex.; Murfreesboro, Tenn., address the City Illuminating Co.; Athens, Ga., address R. L. Bloomfield.

Peabody, Mass.—It is reported that this town will petition the legislature for right to build and operate a plant for municipal and commercial purposes.

Hoboken, N. J.—It is reported that the Lackawanna officials have decided to light the long tunnel just outside this city with electricity.

Richmond, Va.—City Engineer Cutshaw is preparing plans for a municipal lighting plant.

Newberry, N. C.—Maj. W. C. Whitney, of Anderson, is preparing estimates for constructing an electric light plant and water-works in this city.

Columbus, O.—The Columbus Electric Light & Power Co. has received a five year contract for lighting the city with 800 or more 2,000-c. p. lamps, with all lamps, wires and fixtures complete, at $75 per lamp-year, the lights to be run during all the dark hours.

Indianapolis, Ind.—The council has rejected all the street lighting bids recently received, and has called for others. Two sets of plans have been prepared, one calling for 400, 500, 600, 700 and 800 lights of 2,000 c. p. The second proposition calls for the construction of a power plant capable of operating 1,000 arc lights of 2,000 c. p., and dynamos for 650 lights of the same brilliancy.

Sulphur Springs, Tex.—A. P. Landers will receive bids until April 1 for the erection of an electric light and water-works plant.

Electric Power.—*Chicago, Ill.*—It is reported that the Thomson-Houston Co. has proposed to operate four of the swing bridges in this city by electricity, and that a test will soon be made with one bridge.

New Companies.—Montrose Electric Co., Chicago, Ill.; capital stock, $100,000; incorporators, A. H. and F. M. Floaten, F. M. Longfellow and others Continental Electric Construction Co., Chicago, Ill., capital stock, $250,000; incorporators, W. F. and L. C. Orrell, O. I. A. Heat, Marion City, Kan., Water, Land, Electric & Power Co.; capital stock, $150,000; incorporators, S. L. Gillett, S. J. Friendly, and others, of Elmira, N. Y.

CONTRACTING.

Dike.—Proposals for the construction of a pile and stone dike in the Delaware River at Bulkhead Bar were opened Feb. 23 by Major C. W. Raymond, U. S. Engineer Office, Philadelphia, Pa. It was recommended that the contract be awarded to Isaac Hathaway, of Philadelphia, the lowest bidder, at the following prices: 65,000 lin. ft. of oak piles, at 24 cts. per lin. ft.; 4,000 lin. ft. of Delaware pine piles at 14 cts.; 87,000 ft. B. M. of Georgia or Florida pine timber, at $35 per 1,000 ft. B. M.; 34,000 ft. B. M. of oak timber, at $36; 34,000 lbs. of wrought iron tie rods, screw bolts and washers, and 5,000 lbs. of wrought iron drift bolts, at 4 cts. per lb.; 21,000 cu. yds. of stone filling, $1.33 per cu. yd.; total, $49,919. Prices ranged as follows: Oak piles, 24 to 30 cts. per ft.; pine piles, 13 to 16 cts.; pine timber, $35 to $39; oak timer, $36 to $45; wrought iron, 3 to 4 cts. per lb.; totals, $49,919 to $53,101.

Jetties.—*Fort Monroe, Va.*—The following proposals for the construction of 1 600 lin. ft. of pile jetties were opened Feb. 21 by Lt.-Col. P. C. Hains, U. S. Engineer Office, Washington, D. C.: F. J. Kelly, Guttenberg, N. Y., $6.15 or $3.67 per lin. ft. for furnishing all materials, or all materials except piles; I. H. Hathaway, Philadelphia, Pa., $6.85 or $5 per lin. ft.; W. B. Brooks, Jr., Baltimore, Md., $6.74 or $5.64 per lin. ft.

Dredging.—The following proposals for dredging at various points were opened Feb. 21 by Col. P. C. Hains, U. S. Engineer Office, Washington, D. C.: Potomac at Mt. Vernon; Baltimore Dredging Co., 12¾ cts. per cu. yd.; Atlas Dredging Co., Wilmington, Del., 12½ cts.; C. T. Caler, Norfolk, Va., 13¾ cts.; F. C. Somers, Camden, N. J., 11½ cts. Occoquan Creek; Baltimore Dredging Co. 18.1 cts.; C. T. Caler, 22 cts.; B. McConnell, Washington, 10½ and 14½ cts.; F. C. Somers, 18 cts. Aquia Creek; Baltimore Dredging Co., 19 cts.; F. C. Somers, 18 cts. Nomini Creek; Baltimore Dredging Co. 30 cts.; F. L. Somers, Washington, 26½ cts.; C. T. Caler, 27¼ cts. Breton Bay; Baltimore Dredging Co., 12½ cts.; C. T. Caler, 15 cts.; G. C. Fobes & Co.; Baltimore, 14 cts.; F. C. Somers, 13½ cts. Patuxent River; Baltimore Dredging Co., 19¾ cts.; C. T. Caler, 23½ cts.; F. C. Somers, 20 cts. Urbana Creek; Baltimore Dredging Co., 30 cts.; F. L. Somers, 29 cts.; C. T. Caler, 32 cts. York River; Baltimore Dredging Co., 14⅞ cts.; G. C. Fobes & Co., 15½ cts., American Dredging Co., Philadelphia, 16 cts.; F. C. Somers, 16½ cts.; Atlas Dredging Co., 17 cts.; C. T. Caler, 17¼ cts.

Pier Work.—The following were the lowest bids received by Major Stickney, U. S. Engineer Office, Buffalo, N. Y.: Rebuilding superstructure of piers at Olcott harbor: Ira Farnsworth, Lockport, N. Y., $9,266; highest bid, $18,737. Building and repair of breakwater and piers at Dunkirk harbor: G. C. Guinard, Buffalo, N. Y., $14,970; highest bid, $27,046. Extension of North pier at Erie harbor: J. B. Donnelly, Oswego, N. Y., $33 526; highest bid, $93,531.

Lock.—The following proposals have been received by Lieut. Col. J. W. Barlow, U. S. Engineer Office, Nashville, Tenn., for building cofferdam, excavating lock pit, paving bank and building lock No. 2, Cumberland River, near Nashville: Rich & Holmes, Nashville, $163,500; C. A. Locke, Nashville, $185,000; W. R. Patrick, New York, $196,600; John Hogue, Jr., Pittsburg, Pa., $210,172. The contract was awarded to Rich & Holmes.

Sewers. *Waltham, Mass.*—The contracts for sections Nos. 2 and 3 of the new sewerage system have been awarded to Clements Bros., of Cleveland, O. The contract for section No. 1 has not yet been awarded. The contract prices were as follows: Section No. 2: earth excavation, 53 cts. per cu. yd. to 8 ft. deep, 70 cts. to 14 ft., 85 cts. to 20 ft., $1 10 to 26 ft.; rock excavation, $4.50 per cu. yd. to 8 feet deep; brick masonary, $4 .50 per cu. yd.; pipe laying, 6 cts. per lin. ft.; chimneys, 6 cts. per vertical ft.; paving around manholes, $3.50 per sq. yd.; total, $55,162 Section No. 3: earth excavation, 48, 65, 80 cts. and $1 per cu. yd. according to depth as above; rock excavation, $4.50 per cu. yd. to 8 ft. deep, $5 per cu. yd. to 20 ft.; brick masonry, $4.50 per cu. yd.; concrete masonry, $3.25 per cu yd.; pipe laying, 6 cts. per lin. ft.; chimneys, 6 cts. per vertical ft.; underdrain, 25 cts. per lin. ft.; paving around manholes, $3.50 per sq. yd.; total, $57,780.

Street Work.—*Newark, O.*—Prices of bids received last week for brick paving ranged as follows: Fire-brick pavement, $1.04 to $1.37 per sq. yd.; Berea stone curbing, 45 cts. per ft.; sandstone curbing, 33 and 35 cts. per ft.; resetting old curb, 12½ to 17 cts. per ft.

Augusta, Ga.—A bid for paving the streets with vitrified brick, at $1.85 per sq. yd., has been made by Pierce Young.

Vancouver, Wash.—Cedar block paving is to be laid. The cost is estimated by Mr. Homan, City Engineer, at $1.24 per sq. yd.

PROPOSALS OPEN.

Canal.—*Maxwell, Cal.*—About 971,161 cu. yds. of excavation for Central Irrigation Canal. R. De Lappe, March 12.

Bridges.—Wooden foot bridge across Sidling Hill Creek. John Stewart, Clerk of Allegany Co. Commissioners, Cumberland, Md. March 3.

Two iron and cable bridges across Chariton River. R. D. Edwards, clerk of Chariton Co., Keytesville, Mo March 3.

Jail.—*Rocky Mount, Va.*—Six iron cells for four prisoners each. J. J. Carper, Clerk of Franklin Co. Board of Supervisors. March 20.

Dike.—Temporary timber dike in Shrewsbury River, North Branch, N. J. Capt. T. L. Casey, U. S. Engineer Office, Whitehall St., New York, N. Y. March 20.

Buildings.—*Troy, N. Y.*—Masonry of U. S. Government buildings. J. H. Windrim, supervising Architect, Treasury Department, Washington, D. C. March 9.

Orlando, Fla.—Court house. Architect, A. S. Wagner, Williamsport, Pa. C. E. Smith, Chairman of Board of County Commissioners. March 21.

Street Work.—*Norwood, O.*—Trinidad asphalt paving on Floral Ave. D. S. Hosbrook, Engineer, Court house. March 21.

Brooklyn, N. Y.—Flagging sidewalks. Department of City Works. March 5.

Gravel.—*New York, N. Y.*—About 7,000 cu. yds. of screened gravel. Department of Public Parks, 49 Chambers St. March 4.

Bonds.—*Cheyenne, Wyo.*—Water funding bonds, $88,000; viaduct bonds, $60,000; water bonds, $65,000. Frank Dana, City Clerk. March 17.

Jetties.—At Patchogue River and Brown's Creek, Long Island. Col. D. C. Houston, U. S. Engineer Office, New York City. March 26.

Water-Works Supplies.—*Allegheny, Pa.*—Pipe, branches, sleeves, gates, castings, pig lead, etc. James Brown, Comptroller. March 6.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Rogers Locomotive Works, of Paterson, N. J., have an order for 4 ten-wheel engines, with cylinders 19 × 24 ins., for the Norfolk & Western, and are building 10 engines for the Chicago & Grand Trunk. The Pittsburg Locomotive Works, of Pittsburg, Pa., have built 4 ten-wheel engines for the Iowa Central; they have 18 × 24 in. cylinders and 48-in. driving wheels, and weigh 100,000 lbs. The Baldwin Locomotive Works, of Philadelphia Pa., have an order for 13 engines for the Georgia Central. The Cooke Locomotive Works, of Paterson, N. J., have an order for 5 ten-wheel freight and 2 ten-wheel passenger engines for the Long Island. The Schenectady Locomotive Works, of Schenectady, N. Y., are building 3 switch engines for the Long Island. The Foote & Zuber Lumber Co., of Wenona, Ga., wants an 18 or 20-ton engine.

Cars.—The Michigan Car Co., of Detroit, Mich., has an order for 1,000 box cars, 250 platform cars, and 150 gondolas for the Rome, Watertown & Ogdensburg. The Kingston Car Works, of Kingston, Ont., is building 75 freight cars. The Ohio Falls Car Co., of Jeffersonville Ind., is building 200 freight cars for the Nashville, Chattanooga & St. Louis. Two steel cars are said to have been built at works at Desplaines, Ill. The Roanoke Machine Works, of Roanoke, Va., have built a private car for the General Manager of the Norfolk & Western; it is carried on six-wheel trucks with steel-tired paper wheels, and is fitted with electric light and bells.

Locomotive Works.—Plans for the buildings of the Grant Locomotive Works at Chicago have been prepared by Raeder, Claflin & Crocker. They will include a 2 story office and store, 130 × 50 ft.; machine shop, 370 × 110 ft. and 38 ft high; erecting shop, 225 ft. long, 38 ft. high; blacksmith shop, 250 × 80 ft., 22 ft. high; hammer shop, 80 × 125 ft.; boiler and tank shop, 100 × 250 ft.; wood shop, 70 × 230 ft.; paint shop, 170 × 70 ft., 20 ft. high; pattern shop, 130 × 60 ft. width; foundry, building 260 × 80 ft., with cupola, brass foundry and cooling room. The buildings will be of brick, and work will be commenced in the spring or summer.

The American Permanent Way Co. has been incorporated by James C. Drayton, Col. Alfred Wagstaff, J. McLean Nash, Henry Gribble and T. G. Gribble, to control and work the various patents granted to T. G. Gribble, C. E., for street railways, steam railways and subway construction. The office is at 76 Broad St., New York City. The Gribble track was described in ENGINEERING NEWS, Dec. 20, 1890.

Street Railway Track.—The Gibbon "duplex" track is commended, in a letter to the *Electrical Review*, by Mr. E. T. GILLILAND, an electrical expert, who recommends it, after investigation, for electrical railways, as a cure for the prevailing "low-joint," for its probable permanence and consequent low maintenance account, and for its practical continuity of track, which he says is ample for a transmission of the return current without wiring. A full description of this track will be found in ENGINEERING NEWS, Nov. 15, 1890.

Road Work.—The Winston Land & Improvement Co., of Winston, N. C., wants a road machine and grading implements.

Steel.—The Imperial Steel Co., handling the Imperial self-hardening steel, has gone out of existence, the time of partnership having expired. Mr. Adam Tindel, of the Frankford Steel Works, Philadelphia, Pa., has made improvements in self-hardening steel, and has organized the American Steel Co. to manufacture his air-hardening steel.

The Laidlaw & Dunn Co., of Cincinnati, O., is furnishing the Radford Pipe & Foundry Co., of Radford, Va., with 300 HP. of Galloway boilers and 6 steam pumps, including a duplex pumping engine of 2,000,000 galls. capacity to supply the works and the village.

The Walworth Mfg. Co., of Boston, Mass., has erected works for the manufacture of iron poles for electric railways.

The National Water Purifying Co., of New York, has increased the capacity of its filter plant at the Southern Hotel, St. Louis, Mo., making it the largest hotel filter plant in the country.

New Companies.—Aluminum Steel Tool Co., of Chicago, Ill.; incorporators, W. H. Freeman, F. C. Rutan and T. J. Thompson; capital stock, $100,000. Concrete Post Mfg. Co., of East St. Louis, Ill.; capital stock, $100,000. Klein-Logan Steel Co., of Pittsburg, Pa.; incorporators, Frederick C. Klein, E. P. Logan and J. C. Klein; capital stock, $100,000. Lang & Goodhue Mfg. Co., of Burlington, Vt.; to manufacture and deal in pumping and other engines, water-works construction, etc.; incorporators, W. H. Lang, A. J. Goodhue, U. A. Woodbury and C. A. Hibbard; capital stock, $80,000. Alabama Iron & Steel Co., of Birmingham, Ala.; incorporators, Caldwell Bradsbaw and others; capital stock, $1,000,000. Olney Paving Brick & Tile Co., of Olney, Ill.; incorporators, W. A. Cope, J. H. Hundley and James Hollister; capital stock, $50,000. Tobey Construction Co., of Chicago, Ill.; to build railways, etc.; incorporators, Geo. H. Tobey, G. A. Wutkep and A. D. Eddy; capital stock, $500,000. American Balance Slide Valve Co., of San Francisco, Cal.; incorporators, H. McKarrow, J. T. Wilson, I. H. Parks; capital stock, $10,000. Calvin Tomkins Co., of New York, N. Y.; to deal in construction supplies; capital stock, $25,000. Fontaine Safety Signal Co., of Detroit, Mich.; incorporators, R. B. Owen, D. R. Shaw and Wm. K. Anderson; capital stock, $1,500,000.

Metal Market Prices.—*Rails.*—New York: $30; old rails, $22 to $22.50 for iron and $20 for steel. Pittsburg: $26.50 to $27; old rails, $25.50 to $26 for iron, and $18 to $18.50 for steel. Chicago: $31 to $32.50; old rails, $23 to $23.50 for iron and $15 to $18.50 for steel.

Foundry Pig Iron.—New York: $14 to $17.50. Pittsburg: $14.75 to $16.75. Chicago: $14.50 to $16.

Track Materials.—New York: steel angle bars, 1.75 to 1.80 cts.; spikes, $1.90 to $1.95; track bolts, 2.65 to 2.75 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.9 to 2 cts. for iron or steel; iron or steel spikes, 2.05 cts.; iron track bolts, 2.8 cts. with square, and 2.9 cts. with hexagon nuts. Chicago: splice bars, 1.95 to 2 cts. for iron; spikes, 2 to to 2.1 cts.; track bolts, 2.8 to 3 cts. with hexagon nuts.

Pipe.—Cast iron, $27 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.25 to 4.30 cts. Chicago, 4 1 cts. St. Louis, 4.30 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 to 2.1 cts.; tees, 2.5 to 2.75 cts.; sheared iron plates, 2.05 to 2.25 cts.; steel plates, 2.05 to 2.15 cts. for tank, 2.35 to 2.6 cts. for shell, 2.6 to 2.7 cts. for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2.1 to 2.2 cts.; tees, 2.85 cts.; universal iron mill plates, 2.2 cts.; sheared steel bridge plates, 2.4 to 2.45 cts.; refined bars, 1.9 to 1.95 cts.; steel plates, 2.25 to 2.35 cts. for tank, 2.6 to 2.7 cts. for shell, 2.8 to 2.9 cts. for flange, 4.25 to 4.5 cts. for firebox. Chicago: beams, 3.2 cts.; channels 3.2 cts.; angles, 2.25 to 2.35 cts.; tees, 2.7 to 2.85 cts.; universal plates, 2.3 to 2.4 cts.; sheared plates, 2.5 to 2.6 cts. for iron and 2.6 to 2.7 cts. for steel; steel plates, 2.65 to 2.75 cts. for tank, 3.25 cts. for shell, 3.5 cts. for flange, 4.25 to 5.5 cts. for firebox; boiler rivets, 4 to 25 cts.